PD-ABM-072
96137

WORLD ENVIRONMENT CENTER

CZECH REPUBLIC

WASTE MINIMIZATION PROGRAM

AT

VIADRUS ZDB IN BOHUMIN

PROGRESS REPORT NO. 1

WORLD ENVIRONMENT CENTER
419 PARK AVENUE SOUTH, SUITE 1800
NEW YORK, NEW YORK 10016

SEPTEMBER 1995

DISCLAIMER

The opinions expressed herein are the professional opinions of the author and do not represent the official position of the Government of the United States or the World Environment Center.

REPORT DISTRIBUTION:

Michael Kalinoski, Project Officer, Bureau for Europe and New Independent States, United States Agency for International Development

James Bednar, USAID Representative, Prague, Czech Republic

Patricia A. Swahn, Acquisitions Manager, Document Acquisitions, United States Agency for International Development

Ludmila Hofmanova, WEC Coordinator, Prague, Czech Republic

Antony G. Marcil

George Carter

Thomas J. McGrath

Romuald Michalek

Bohdan Aftanas

B. Bhushan Lodh

Frank Szymborski

Valerie Sepe

Bill Beck

Gary Wandtke

Gustav Wieczorek, Good Economic Systems, Ltd., Bohumin, Czech Republic

Zdenek Chury, Director, Viadrus ZDB, Bohumin, Czech Republic

TABLE OF CONTENTS

		Page
I.	Introduction	
II.	Beck Consulting Company Report	
	1. Summary	II-1
	2. Background	II-1
	3. Waste Minimization Program Comments	II-1
	3.1 Management commitment	II-2
	3.2 Program implementation - selection of areas	II-2
	3.3 Waste identification	II-2
	3.4 Cost accounting	II-3
	3.5 Practice and procedure	II-3
	3.6 Worker/mechanic involvement	II-3
	3.7 Document the program elements	II-3
	3.8 Check the manual and workbook	II-4
	4. Particular Waste Problems	II-4
III.	Good Economic Systems Ltd. Report	
	1. Introduction	III-1
	2. Negotiations	III-2
	3. Conclusions Gathered at Sessions	III-3
	4. Final Conclusions	III-5
IV.	Gary Wandtke Report	
	1. Introduction	IV-1
	2. Waste Minimization Techniques	IV-2
	3. Findings	IV-2
	4. Conclusions and Recommendations	IV-5
	5. Cost and Payback Information	IV-8
V.	Attachments to Beck Consulting Co. Report	
	1. Engineered Scrubbing Systems - by Mousanto Enviro-Chem. Systems, Inc.	V-1
	2. Electrostatic Precipitators - by United McGill Co.	V-2
VI.	Attachments to G. Wandtke Report	
	1. Business Cards of Persons Contacted	VI-1
	2. The Ashland Process	VI-2
	3. Industry News - Metal Casting Associations	VI-3
	4. Summary of Foundry Sand Reuse Options in Ohio and Wisconsin	VI-4
	5. Beneficial Use of Non-Toxic Bottom Ash, Fly Ash and Spent Foundry Sand, and Other Exempt Wastes	VI-5
	6. Tooling Design by Ashland Chemical	VI-6
	7. Typical Properties - Warm Box Products	VI-7
	8. Curiculum Vitae of Gary G. Wandtke	VI-8
VII.	Organizational Charts of Viadrus Co.	VII-1 - VII-12

I. INTRODUCTION

In July 1995, under the technical assistance program for Central and Eastern European countries funded by the United States Agency for International Development (USAID), the World Environment Center's (WEC's) team visited the ZDB Viadrus Foundry in Bohumin, Czech Republic. The team consisted of Mr. Thomas McGrath, Vice President of WEC, Ms. Ludmila Hofmanova, WEC's in-country coordinator, Mr. Bill Beck, consultant of Beck Consulting Company, Mr. Gary Wandtke, volunteer specialist of Ashland, Inc., and Messrs. Gustav Wieczorek and Pavel Marek, both from Good Economic Systems, Ltd. (GES), a Czech consulting company at Bohumin.

The purpose of the visit was to establish a waste minimization program at the ZDB Viadrus Company by incorporating WEC's 10 step procedure which is as follows:

1. Develop a Policy and Management Committee;

2. Set Up an Organization and Select a Site Steering Team;

3. Divide the Plant into Areas for Creation of Area Teams;

4. Develop and Train the Area Teams;

5. Establish Waste Identification and Accounting System;

6. Develop Cost Accounting;

7. Establish Initial Priorities and Goals;

8. Perform Waste Minimization Analysis and Planning;

9. Develop Schedule for Implementation; and

10. Follow-up.

The intent of this project at ZDB Viadrus Company is to establish a **waste minimization model program** for replication by other enterprises in the Czech Republic.

Each WEC team member during this visit had specific assignments that were as follows:

- Mr. T. McGrath had overall responsibility for establishing the project;

- Ms. L. Hofmanova had responsibility to coordinate the project;

- Mr. B. Beck had the task of assisting in instituting a permanent waste minimization organization at the plant;

- Mr. G. Wandtke performed an environmental review of the foundry operation, developed recommendations for improvements, and assisted in identifying areas for possible waste reduction; and

- Messrs. G. Wieczorek and P. Marek provided consulting services to ZDB Viadrus Co. for the duration of the implementation of WEC's Waste Minimization Model Project.

This volume includes three (3) separate reports prepared by Beck Consulting Co., Good Economic System Ltd., and Mr. Gary Wandkte.

II. BECK CONSULTING CO.

REPORT

1. SUMMARY

As a part of the WEC Waste Minimization Implementation Program for Central Europe, the boiler foundry of Viadrus-ZDB in the Czech Republic agreed to participate in a model plant program on waste minimization. This plant was visited by the WEC team for the purpose of providing on-the-site training and consultation to the Viadrus waste minimization team leaders and to their environmental contractor, GES The approach and commitment to waste minimization by the management was found to be excellent, and by implementing the ideas and suggestions made to Mr. Bury, the site team leader, Viadrus should be able to follow through with a solid program.

In addition to the waste minimization training, Viadrus proposed five problem areas of greatest concern for brainstorming some solutions. These will be discussed as an addendum to this report.

2. BACKGROUND

Viadrus Heating Technology Division is a large integrated manufacturer of cast iron heat exchanger components and boilers and home and industrial radiator heaters. They have been in this business for many years and have a world-wide market. They use scrap metal as the primary ingredient, and this in itself is a waste minimization accomplishment. Molten iron, processed in hot-blast cupola furnaces, is cast into heat exchanger components in sand molds, around cores that are manufactured also by Viadrus. Portions of this core making and component molding process are automated, but a significant amount of hand labor is used, especially in the quality testing of semi-finished components. Viadrus' quality program has earned numerous endorsements from its customers and international certification organizations. Its ISO 9001 certification is well underway.

Viadrus has embarked on an environmental improvement program as a part of its overall commitment to manufacturing excellence and has engaged a local business consultant, GES, to provide some consulting services in this regard. It is recognized that the ecology effort cannot be isolated from an overall environmental program. Also, the construction of a state of the art lined landfill and the installation of a superior dust collection system on one bank of furnaces are impressive evidence of this commitment.

3. WASTE MINIMIZATION PROGRAM COMMENTS

The following comments are offered to complement and reinforce the discussions held at the factory during our visit. They will try to summarize the points we covered on our review session on Thursday.

3.1 Management commitment

While it is quite evident that the management of Viadrus is committed to this very important program that has both economic and environmental benefits, the communication of the commitment, and the day to day demonstration of it, is sometimes not easy to accomplish. Too often management believes that such a commitment ought to be obvious because of some ecological investment, or because it is stated in its annual financial report. These measures are good, but they may not be understood by the plant workers or the residents of the community.

This must also be backed up with the development of long range vision of where Viadrus management wants the company to be in three years, five years, ten years. This vision will naturally create goals and "milestones" for the environmental program, including the waste minimization program. Since the environmental program is so closely linked with the products, and the wastes that might be caused in their production, it is necessary that this long range plan be a combined business/environmental plan.

The output from such a planning process will be a comprehensive statement of this long range vision, as well as the expected milestones and goals. Moreover, the necessary resources, people, time, and where appropriate, expenses, will be identified and made available (the ACME Corporation example in the WEC program implementation booklet illustrates this).

This management commitment also requires that management play an active part in starting the waste minimization program and in working with the teams as they begin to set up the program. Moreover, management should expect periodic reports from the teams on planning, problems and progress. In this regard, if the teams select large and difficult to solve waste problems, then it will take a lot longer for these to be accomplished. Its better for the program if smaller and more quickly solved problems are selected.

3.2 Program implementation - selection of areas

As was pointed out during our visit, the foundry has some very obvious areas for use in the waste minimization program. For example, the mold forming area, the cupola area, the mold building area, the paint area, etc., are obvious areas for individual teams. Two things to remember in area designation and in getting started are: 1.) do not create illogical areas or ones that are too large and complex, and 2.) do not try to start the program across the entire plant at once. I believe that these points were understood by Viadrus and GES.

3.3 Waste identification

The lists of wastes that are developed and shown to us appeared to be too general, or "mixed," for the purposes of identifying the source and causes. One of the major reasons

for the success of the WEC program is that it stresses the focus on individual wastes and sources. For example, in the core forming area, there are a number of machines doing the same activity of compacting mold sand into the core cavities. If the wastes (sand and binder) from all these machines are collected into one metal drum, it will be impossible to determine which machine or machines might be improperly adjusted, and thereby causing the amount of waste sand to double in volume within one day's time. Another situation to illustrate this is the problem of core breakage. If all broken cores were collected at one place, it would be difficult to identify if loading, transporting or unloading was the activity that contributed to the overall increase in core breakage.

3.4 Cost accounting

Viadrus appears to have some information developed on the cost of waste disposal and on the fees that are charged by the government on these wastes. However, the cost of ingredients, the cost of lost production, and the avoided costs of future facilities, such as a new landfill, need to be factored into the cost accounting process.

3.5 Practice and procedures

Even before the Viadrus waste minimization program starts up, it is easy to note that there were a number of procedures, practices, and maintenance activities that could be studied by the waste minimization teams for the purpose of improving them and reducing wastes. This is often difficult for workers and their management to recognize. Perhaps it is because these activities are so routing and have not been questioned or examined.

3.6 Worker/mechanic involvement

For the waste minimization program at Viadrus to be successful, it must be put into the hands of the workers and mechanics. The engineers and first line management cannot pull together all of the knowledge of waste and their causes without help from the people who operate and maintain the machinery day after day. To be sure, a program run by the technical department will make some progress but usually after some expensive new piece of equipment has been installed. The low/no cost program of small projects, of changes in procedures and practices, requires the skills and knowledge of the workers.

3.7 Document the program elements

Several companies that have started waste minimization programs have quickly "run out of gas" because they did not start out with a clear idea of what they were trying to accomplish, or what background information existed on waste or attempts to reduce the wastes. Said simply, there was no documentation. Such a situation leads either to no action or confusion, neither of which are good for the program. To avoid this problem, Viadrus should develop a set of forms for program documentation ahead of time and provide this set to the teams as they get started so that their area programs can begin the

habit of documentation immediately. This "model" documentation should include an example so that there is a clear understanding as to what is expected.

3.8 Check the manual and workbook

There will be some unusual situations or questions generated by implementing this program for which you may not have the answers. My first suggestion is to try to find the answer or an example in the WEC manual or workshop workbook. The implementation seminar and its ACME examples are another place to check. However, for some situations there are no pat answers and you will have to develop your own. The consultants at GES should also be able to help. Do not be afraid to make a decision that is wrong; there aren't any. Since this is a Viadrus program, you can make your own rules and decisions - as long as they are directed toward protecting the environment and reducing wastes, they should be correct.

4. PARTICULAR WASTE PROBLEMS

During the recent visit to the Viadrus foundry by the WEC team of experts, the foundry management presented the team with five waste generation problems where specific help was needed. The team, Mr. Gary Wandtke of Ashland Chemical, and Mr. William Beck of Beck Consulting, agreed to provide some additional comments on these problems after returning to the U.S. where more references were available. The following comments on two of the problems represent the fulfillment of the commitment.

Problem 1 - Excessive Cupola Emissions of Fine Particulates

While this problem will be discussed by Mr. Wandtke in his report, I have also developed some ideas and suggestions on this subject. The present system uses a cyclone and a wet scrubber to remove the fine particulate from the hot exhaust gases leaving the cupola. A sketch of this system was provided to us but it lacked some details necessary to perform a strict engineering assessment. However, there are some points and suggestions I can make.

1. Adequacy of design of the cyclone and scrubber

I have frequently seen situations where the design basis for gas cleaning equipment differs from actual conditions, resulting in poor performance. Continuously overloading this type of equipment with too high a gas flow, or with a greater particulate loading, will result in inadequate removal/capture. A related question might be: is this the best equipment design for the application? In the U.S., as a result of the very tight environmental regulations, considerable advances have been made on removing particles from gas exhausts.

I have taken the liberty of discussing your problem with an expert consultant, who until recently worked for DuPont. He is now an independent consultant, but sometimes works

with the Monsanto Enviro-Systems group. They have licensed the reverse jet scrubber technology from DuPont and this former DuPont expert, Mr. Dan Macintosh, helped develop it. Mr. Macintosh believes that this reverse jet scrubber could solve your problem because it is extremely efficient. He has offered to custom design a scrubber that Viadrus could fabricate themselves. If this is of interest, I can put Mr. Macintosh in contact with Viadrus. He will need a sample of the particulate to determine particle size distribution and other parameters. I have included a brochure that describes the reverse jet in general.

2. Correct operation

One common problem with scrubbers is that they are quite prone to fouling and channeling so that they lose their efficiency. If this scrubber has spray nozzles or some type of pecking and water distribution system, I would check it out carefully to make sure it was operating per design. Frequently changing out the packing for a more efficient design can improve the performance of a system.

Problem 2 - Excessive Organic Vapors from the Painting Area

This area has two problems - excessive levels of solvent in the work area, with worker exposure considerations, and excessive emissions of solvent to the atmosphere. The classical approach to the personnel exposure problem is to close up the paint dipping and drag out area so that the worker inspecting the quality of the coating can do so isolated from the odors. Is this degree of inspection necessary? How many rejects are caught by this 100% inspection program? Evidently, Viadrus believes the quality of paint application for the present systems need this checking.

When asked if water-based paint might work, the reply of "no" suggested that the quality dictated a grease cutting solvent paint system was necessary. Perhaps the cast parts could be cleaned in a detergent system as a substitute.

Newer paint formulations and systems might be investigated, including dry powder paint systems. Any of these solutions would automatically solve both of the current problems. Also, it should be pointed out that an emission control system to eliminate discharges and odors to the air will be expensive. It may be cheaper overall to change the paint system.

III. GOOD ECONOMIC SYSTEMS LTD.

REPORT

R E P O R T

on the work session of the fact-finding team consisting of representatives of the WORLD ENVIRONMENT CENTER (WEC) from the United States, the GOOD ECONOMIC SYSTEM, Ltd Co. (GES Co.) of Ostrava (CR) and of the VIADRUS Company, manufacturer of heating technologies which is based in Bohumin, a suburb of Ostrava, held to introduce the "Waste Minimalization Program."

1. Introduction

During the first half of the last year, the Viadrus Company launched work on a project entitled "Environmentally Minded Management Policies." This was a pilot project for the Czech Republic and its implementation was jointly supervised by the GES Company and by the Czech Ecological Managerial Center of Prague (CEMC). The project is developed from the British Standard No.7750 - "Requirements for the Introduction of Environmental Business Management." It is also derived from the EU Council Regulation No. 1836 concerning voluntary participation of industrial enterprises in environmental policy management and auditing, and also from proposed ISO 14000 standards.

Besides reducing negative environmental impact the project is aimed at increasing business efficiency and competitiveness on domestic as well as on foreign markets.

The "Introductory Analysis in Detail" elaborated in the course of last year forms the basis for primary implementation areas for this year, emphasizing those having top priority. It deals with managerial decisions, technological facilities, flow of material, manufactured goods and the human factor while stressing streamlining of waste management and environmental awareness in manufacturing technologies.

In support of these two ideas, the GES Co. initiated contact with the WEC and arranged for a visit of WEC expert work group at the Viadrus plant to present the "Waste Minimalization Program" and then assist with its implementation.

10

2. Negotiations

The working sessions were held among the representatives of the WEC, the GES Co. and Viadrus from June 12 to June 16

The basic work group was composed of:

WEC	T.J. McGrath	- vice-president
	W.B Beck	- of Beck Consulting
	G.G. Wandtke	- Ashland Corp. executive
	L. Hofmanova	- Prague office director
GES Co. & Viadrus Co.	G. Wieczorek	- president
	P. Marek	- executive
	Z. Chury	- executive director
	L. Rosman	- director for technology
	R. Salbut	- foreman in the boiler foundry
	I. Bury	- head of technical development
	I. Dostal	- quality control executive

Joint sessions were held on June 12 and 13 The first day the participants spent to introduce themselves to each other. WEC reps were then acquainted with work progress on the environmental management policy project, on its results and on the acquisition of know-how from its implementation. WEC people considered their observations as highly positive, in many instances noted those elements which facilitate program introduction at the Viadrus Company plant.

The second day was mainly spent at an excursion to the plant to see the boiler and other heating component production facilities. They also visited the newly opened ZDB Company waste repository. The excursion resulted in first suggestions and comments by center's experts in regard to waste reduction, but primarily on questions of environmental aspects in industrial production.

From June 14, by mutual agreement, the combine work team was divided into two separate groups.

1. Technological group
Composition: Messrs. Wandtke, Rosman, Salbut, Dostal but also including additional Viadrus employees who were called upon according to their area of expertise.

2. Systemic group delegated with introduction of waste program at the Viadrus plant
Composition, Ms. Hofmanova, Messrs. McGrath, Beck, Chury, Wieczorek, Bury and Marek.

3. Conclusions gathered at sessions

3.1 Conclusions made by the technological group

The WEC experts positively assessed the Viadrus objectives and the company's approach to dealing with selected problems thus far by confirming their validity and also presenting some additional ideas.

× Completion of CO gas incineration in a Prodlew-type (cupola) furnace chimney requires regulation of air supply in order to improve consistency of flammable mixture in order to achieve best equilibrium of gas to air ratio.
× Existing MBC (cupola) furnaces must be replaced by induction melting furnaces capable of environmentally safe operation.

× Mechanical regenerating equipment should be installed to dispose of heater-body core residues and unspent core mixture production made waste-free by using the Thermoshock method. The preference must be given to regeneration instead of the a thermal method.
× Special attention must be paid to the handling of raw-core mixtures in order to prevent gas production as well as core gassing.
× The Thermoshock method must be also applied to furan technology, namely to the COLD-BOX process, as to prevent phenol and formaldehyde access into the core mixture.
× Escaping dust emissions which are now handled at the plant by wet-filter separators must be dealt with the installation of several efficient dry filter units Wet separators are not perspective but their replacement "piece by piece" for dry type is not feasible due to high investment cost.
× Suppressing procedures in which heater bodies are dipped into priming synthetic solvent mixtures due to poor environmental safety and considering applying one of these options:
  1. application of non-toxic solvents
  2. application of electrostatic method for coating using powdered paint
  3. sealing existing equipment with an airtight casing and regulate created xylene and tolulene vapors with a neutralization device.

The Viadrus Company leans to the application of the second option and is now ready to draft a comprehensive proposal

12

resolving this problem.

The technological group members also discussed other technological questions and submitted these recommendations:

* Improve de-aeration of core boxes with vent sieves
* Install elastic pads underneath palletized heater body cores
* Seal core boxes against the injector plate by using self-sealing tape as to reduce mixture spatter around the machine.

* Apply SILESE (Ashland Co.-made) anti-adhesion admixture instead of BT-3, K-Leim and crude-oil substances now in use.
* Reduce decay of the COLD BOX cores by adding Fe2O3 into the core mixture.
* Improve all aspects in regard to casting time and to inflow systems.
* Determine properties of forming mixtures and influence factors allowing to attain better quality surfaces
* Develop new approaches to resolving vent systems in COLD-BOX cores.

3.2. Conclusions submitted by the systemic group to introduce the waste program

WEC reps explained all 10 steps required to introduce the program without neglecting to include their latest practical observations and experiences. Many of their remarks proved as highly suitable and applicable for introduction at the Viadrus plant.

The discussion clearly pointed out the the Viadrus Company is more than well-suited for the application of the program. because of some steps already undertaken by the company. These steps mainly include an establishment of cost (load?) centers, a "waste inventarization" study and analyses of all pollution sources. The WEC experts appreciated the level of Viadrus Company's know-how obtained during the implementation of the Environmentally Minded Management Policies Project.

These are the most important recommendations as forwarded:

* the waste program must become a part of everyday activities for all employees
* management team must be formed along with task groups, everyone's responsibilities and methods of communication precisely defined
* clear communications channels initiated within the plant

13

* responsibility for waste reduction be primarily assigned to production departments
* gather maximum information concerning waste and the reason for its origin before any measures can be undertaken
* systemize waste cost monitoring at all levels not only for its liquidation or calculation of fines incurred by pollutant discharge into the environment.
* all costs incurred in handling of waste and its disposal must be conclusively calculated into the final cost of production
* concentrate on eliminating first all reasons for pollutant engendering rather than be faced with problems of actual waste disposal

* set up a schedule to undertake measure according to specific stages ("today" means day, "tomorrow" means months and and the "day after" signifies years), these would correspond in real time which is necessary for applying individual solutions
* some initial program priorities and objectives should be selected to accomplish somewhat facile success in order to heighten employee interest and convince more workers to participate
* smooth-running waste reduction program is facilitated only by a constant flow of new ideas, of innovation proposals or activities as well as by emphasizing close monitoring, evaluation and planning.

4. Final Conclusions

Work session with WEC reps have more than fulfilled their purpose, mainly those talks confirmed validity of a number of elaborated measures, be these technical, technological, organizational or systemic, and which were taken in support of environmental policy at the Viadrus facility.

A need was also demonstrated to deal with every priority set out previously in the RVT Program and also by the Environmentally Minded Management Policies Project.

14

Many observations and recommendations submitted by the WEC group would be applied not only during the implementation of the waste reduction program under the circumstances extant at the Viadrus plant but also in various manufacturing processes this company is using.

Further evaluation of of conclusions reached by WEC representatives will be jointly undertaken by GES and Viadrus experts and this effort could also serve to design additional procedures to implement the minimalization program. This policy should be eventually supplemented by additional observations and recommendations contained in the forthcoming comprehensive report to be submitted by the WEC organization.

Partial consultations concerning the progress of program's application at Viadrus are expected to take place at the WEC nationwide expert seminar which is scheduled for Prague this autumn.

In Ostrava: August 15, 1995.

Elaborated by: Pavel Marek, M. Eng.

IV. GARY WANDTKE REPORT

1. INTRODUCTION

The purpose of this trip was to perform an assessment of the foundry operations at the Viadrus-ZDB a.s. facility in Bohumin, Czech Republic, and to identify particular areas that are pertinent to the waste minimization program. The author is very familiar with foundry metal casting operations and particularly in the environmental and production engineering facets and has over 35 years of experience.

Prior to our team's arrival, Viadrus had identified six areas or "Hot Spots" that connected with both environmental and waste management issues. Of the six items, five originated in the foundry. A plant tour was made to review the operations and the areas in which the "Hot Spots" were located. Because of the uniqueness of the foundry operations, the team split into two groups.

The Waste Minimization Program was continued with most of the staff group and the other team concentrated on foundry operations. The purpose of this was to break down the waste streams as to their causes. The foundry operations take place in two separate areas that are independent of each other. They are the Boiler Foundry and the Radiator Foundry and produce gray iron castings for the company's captive line of home and industrial heating products.

The following six items were under review:

a. fugitive particulate emissions from the boiler cupola melting units;

b. escape of carbon monoxide from the melting cupolas in both foundries;

c. & d. waste sand from the core making and molding operations in both foundries, which were identified as major cost concerns because of a governmental 6. classification that applies fees for disposal of this waste in land fills;

e. a program to reduce the in-plant dust (particulate) load from 100mgs per cubic meter to 10 mgs per cubic meter; and

f. VOC emissions from the painting operation that uses a solvent based paint.

The facilities were well maintained; good house keeping is evident. The equipment and applications are still functional, although obsolete when compared to current state of the art technologies. Newer technology is able to meet newer environmental and production demands while reducing energy requirements. Current equipment in the boiler foundry could be dated at 1950 technology, while the equipment in the radiator foundry could be dated at 1970 technology.

The plants use water bath dust collectors at individual points of control rather than zoned collection. Forty individual units are used and create major amounts of water bearing sludge that needs to be treated and disposed.

2. WASTE MINIMIZATION TECHNIQUES

The waste minimization method used was application of the ten steps outlined in WEC's manual. The implementation of the program was to utilize several of the suggestions offered during the team meetings. The initial start of the program would be conducted by Viadrus personnel, assisted by the GES Company. The foundry core rooms were the most probable starting points, based on core scrap and waste sand at the machine areas.

3. FINDINGS

The boiler foundry cupolas utilize a design that creates the formation of carbon monoxide as a fuel gas to preheat combustion air used for melting. This design requires a warm up cycle at start up and offers a continuous threat of explosion. This design does not easily conform to variation in output. The unit observed had been modified to reduce output from 13 tonnes per hour to 8 tonnes per hour by reducing interior dimensions of the well area and reducing the tuyeres from eight (8) to four (4).

The hot spots at the boiler foundry cupola melting were both excess emissions of carbon monoxide and dirt. Carbon monoxide could escape if back pressures were created in the system and critical temperature for combustion was not meet. Particulate escape is clearly possible during start up when the system was on by-pass and all combustion products could vent directly to the atmosphere.

Another instance when particulate escape is possible involves the presence of material in the process water. Material in the process water will plug the wetting nozzles, which in turn will make it possible for the gas stream to channel through the wet scrubber. The scrubber performs two duties of cooling the gas stream and wetting the particulate to cause it to drop out of suspension. Newer design units accomplish these tasks more efficiently by featuring more compact media and higher flow nozzles.

The radiator foundry cupolas are of a more conventional design. By monitoring charge make up, density, and level in respect to the charge door where oxygen can freely combine with the gases exiting the charge stack, carbon monoxide is converted into carbon dioxide and a level of attainment is normally meet. Changes in output requirements can vary the ability to normally consume the carbon monoxide.

The easiest solution is to provide excess air burners at the charge door. This will insure combustion by supplying both oxygen and temperature. This is the normal remedy, although very strict controls over charge make up, amount of coke in charge,

18

and temperature and volume of blast air can accomplish the same results. This alternate can also be used to vary output of the cupola.

Sand waste in the foundry is common as sand itself is the major media component used. Sand is the major solid waste taken for outside disposal in landfills. Thus, over the years there have been many published papers and opinions on how to conserve its use. Most reclaiming starts on returning the sand mass back into individual grain size and distribution. This can be accomplished by grinding, calcining, pneumatic impingement equipment.

Sand waste is expected because of the changes in grain sizes that occur within the processes of the foundry in which the sand grains are both mechanically and thermally fractured. The grain size of the sand is important and must meet a particular sizing and mix to do the tasks required. The expected loss based on 100 kilograms would be approximately 2 kilograms. Other sand loss is spillage from a variety of sources and reasons and often approaches three (3) percent of new sand purchases. This sand is often contaminated and not easily reused. Current sand disposal rate is 20,000 tonnes per year.

Government fees on this type of sand is relatively low. This type of sand is not toxic and is mostly composed of sand, clay, and some organic and metallic particles. It is also deposited at the old company landfill. One truck load we observed also contained a large number of cast parts including casting, parts runner system and scrap metal. The team agreed that the metallics should be screened from the sand and recycled.

The boiler foundry core area has one particular machine dedicated to making the highest volume cores. This machine utilizes the ASHLAND PROCESS to make cores with a phenolic ureathane binder system cured by an amine gas. (See Exhibit VI-2.) There is no heat used in this process. Cores are ready to use after being taken off the machine. Other cores are made in a different area and utilize heat curing binders.

This area was selected for three separate reasons. 1.) Core scrap and waste mixed sand in an uncured state is disposed of in a company landfill. Although the company owns the land fill, there is a fee imposed by the government on chemical synthetic sand. The fee is very high, approximating 40 kc per tonne, and is expected to escalate rapidly in the near future. Current disposal rate for both foundries is 4,400 tonnes per year. 2) The largest source of uncured sand is from clean up operations at the machine. The second source is sand blow out tooling during the production cycle. The author estimates that this amounts to 75 to 100 kg per day. The largest source of cured core scrap is from cores broken through handling and transporting, amounting to 100 kilograms per day. 3.) The casting's defects increased on some jobs when using cores made from this process.

The radiator foundry produces the highest volume of both castings, molds, and cores. Consequently, it also produces the heaviest waste streams. The emissions are phenols, formaldehyde, dust particulate, sulfur compounds, iron oxides, and others.

The area the author concentrated on in this foundry was the amount of cores broken in handling and transportation. The loss was given at 15% of the daily production and estimated to amount to one (1) to three (3) tonnes per day at 100% capacity. The amount of waste sand in the uncured state at mixer site, transfer belts, and machine area was estimated to 300 kilograms per day. The most waste was at the mixer site based on one sighting in the floor area under the mixer platform.

Both new and mixer sand composed this waste. The machine area was very clean, although traces of blow out sand rapidly accumulated on the floor areas around each machine. The operators were keeping the work area clear. The source of this sand was visible during each invest or blow cycle of the roper machines. The sand blows out on the parting line of the tooling. The mixed sand used here in the Thermo-Shock process is a heat cured phenol-formaldehyde binder using a toluene sulfonic acid as a hardener.

The sand mixed with these chemicals has a short bench life, often as little as two or three hours. The normal result is the sand mix thickens, making it unsuitable to be blown into the tooling. When this happens, the machine hopper must be cleaned and the sand in it discarded. This is recognized as a toxic material and the current practice has been to dilute the resin with another material. A critical aspect is the long "baking" time in the Thermo-Shock ovens. The cured cores resist easy separation from the tooling unless sufficient release is available.

Our concern extends to the exhaust stacks of the Thermo-Shock ovens, due to the products of reaction that are exhausted. Both foundries try to reduce chemical sand disposal by grinding core scrap to grain size and adding this material in the new sand. This is not usually recommended because volatile are increased in the sand mix and this can promote gas defects in the castings using these cores. Uncured sand is not recommended to be mixed with new sand because the reaction may be hindered by evaporation of solvents and the resins could be oxidized. Resultant defects could be excess organics in the mix and poor distribution and coating of the sand grains.

The need for dust reduction is recognized and the molding sand mixing area could be the worst source when in operation on full production. The dust is made up of the clay and organic additions of the mixing formula. The actual charging of the mixers with return sand that also contains the same material and includes fine micron particles of silica further contributes to the problem. These materials, plus the very fine silica sand particulate or fines, become easily airborne.

Other areas that promote dust are the molding machine air blow offs, sand transfer belts, and the mold shake out areas after pouring. The shake area offers the most

difficult area to control fugitive emissions due to heat convection on the particulate matter from not only the mold, but also the decomposition materials in the core sand in side the castings. The control also must include odor reduction.

At this point, foundry classes of waste products are identified as:

- Air contaminate- Carbon monoxide escape with control limit to be 100 milligrams per cubic meter;

- Solid waste-Molding and core sand waste and scrap that is land filled;

- Solid waste-Particulate from Cupola melting furnaces and from the foundries including mixing area. External limit is 80 milligrams per cubic meter. Internal limit established at 10 milligrams per cubic meter and current loading is 100 milligrams per cubic meter;

- Solid waste-Metallic such as miscellaneous cast parts in waste sand that was landfilled;

- Air contaminates- Unidentified and unqualified emissions from Thermos-Shock Shock Ovens;

- Water- Process water loops for cupola cooling and discharges from water dust collectors and scrubbers that utilize settling ponds. Sludge from these ponds represents another solid waste stream.

4. CONCLUSIONS AND RECOMMENDATIONS

4-1. The Boiler Foundry Cupola Operation is not easily changed due to the design of equipment to produce carbon monoxide for fuel. A short term suggestion to control dirt emissions would be to fabricate a capture cap of a fine mesh screen to reduce particulate escape into atmosphere during start-up. The second short term remedy would be to install a secondary filter system, using cartridge filters, on the scrubber spray water supply so nozzles do not become plugged. Carbon monoxide emissions can occur at the by pass section during start-up because there is not adequate retention time in the burner area to consume the gas.

Installing additional burners of the excess air design that are used to burn off gases satisfactorily in the radiator foundry maybe applicable here. A suggestion for a longer term intermediate program would be to shut down the boiler foundry cupolas and charge the holding furnaces with metal produced in the larger cupolas of the Radiator Foundry. The capacity of these cupolas could be utilized to supply both foundries once a transport method and schedule were determined.

At the present time the Radiator Foundry cupolas and the emission capture system can meet current standards. Long term changes would be based on the change over to a different metal melting system that eliminates coke as part of the charge. This single change would eliminate the carbon monoxide source as well reduce drastically the amount of fugitive particulate, particularly metallurgical smoke that is traced to coke. Should this change utilize electric induction melting, collection could be done by dry filtering and eliminate both water quenching and filtering using water, and the sludge produced by this method.

4.-2. The core sand waste and core scrap that is landfilled is the most costly material handling activity of this facility and part of the unrealized cost is that of that construction and operation of the land fill itself. The molding sand waste was delivered to the old land fill and for the most part is made up floor sweepings and collections after the shake out area. The amount of cores consumed in the molding process increases the over all sand contained in the systems.

Much of this material is usable but not recycled due to lack of storage capacity and is generated by both foundry units. Some reduction in the overall amount requires less new sand additions and control over distribution points. The use of screening separation can qualify sand by removing fines and making sand more desirable for recycling. The screening function also removes extraneous material from the sand such as metallics that can be collected and reclaimed.

One way to reduce sand landfilled is to investigate beneficial uses. Examples of beneficial uses are foundation and pipeline fill material and filler material in bituminous road ways. (See Exhibit VI-3.) This alternative does require qualification before implementation and takes considerable time to obtain approvals. The sand from the core areas of both foundries offers the best place to begin the waste minimization program. In my opinion, the reduction of core scrap from broken cores is the prime objective. The radiator foundry creates the most broken cores by transporting.

Our initial suggestions are to investigate where the cores are broken and then why. First suggestions were to supply cushioning media between the cores in the stacking process or to provide a different method or order of stacking the cores to reduce breakage. Intermediate solutions would be a new design core storage and transport container that would reduce shock and provide unbroken cores. Not withstanding, core quality tests should verify cores are consistently produced with suitable strength to resist breaking in normal handling. The ten step program is applicable in this situation. Another source of waste sand in the radiator foundry is uncured core sand. The major source of this sand was traced to spills at the mixer area and the belt distribution and to the Roper machine Area. The sand at the machines was from sand escaping from the tooling during the blow or invest cycle. The sand fluidized by air pressure blows out of the parting line between the upper and lower parts of the tooling used to make cores. Corrective measures are to balance machine clamp pressures in relationship to blow

pressure, factoring in the amount of surface area affected. Parting lines should be tight under normal conditions. The Ashland Chemical Company has used a formula to establish guidelines for blowing cores efficiently and effectively used core vents in the tooling. The use of the formula and the proper vents provides the means of producing consistent quality cores using the least amount of air pressure during the blow cycle to extend length of tooling runs before cleaning and reduce the wear on the tooling due to the sand blast effect. It is noted that the tooling did have vents installed, however, there was some surprise to find out that a formula existed for their use. (See Exhibit VI-6.)

The current chemical binders used for the thermo shock process are considered hazardous due to the phenol, formaldehyde, acid catalysts they contain. These types of binders are being phased out in the United States because of environmental regulation. Newer binder systems are formulated to be free of most toxic materials and there is much emphasis to reduce the amount of binder required to obtain the same or greater tensile development. Indirectly, this will provide higher efficiency in use and in the case of investing or blowing cores provides the means of lowering the air pressures uses because the sand mix is more flowable. Other benefits are cleaner running tooling and longer production runs with core tooling maintenance reduced. There also exists newer technology using a gaseous curing agent to cure the core in the tooling so that it is ready to used upon extraction. The obvious change is no heat is required to finish the cure reaction. Thus the cost of energy and the means to supply it are no longer needed.

Both these types of systems are available to Viadrus now for the radiator foundry. Viadrus is using the Ashland Process in the boiler foundry that has provided improvements in making boiler section cores. An area uncovered here was that a particular design core made in the Ashland Process or cold box produced heavy amounts of scrap castings traced to gas defects or porosity in the section. Inspection of the cores revealed no internal venting and no use of iron oxides to suppress the formation of carbon monoxides and lustrous carbon inside to the mold cavity and relief of gas pressures produced during the pouring cycle. Other factors including long pouring times and low pouring temperatures influence the formation of the above. Immediate remedy is to add a suitable iron oxide at a rate of 1 to 2 percent of the sand weight of the mix. The second step to vent cores either by using vent rods in the tooling or drilling the channels manually. Last steps are to monitor and change pouring rates and or tooling if not improvement was shown after the use of iron oxide and vent practice. Reduction of scrap is within the waste minimization program.

4.-3. Reduction of dust load in the foundry buildings requires an analysis of the point sources of dust generation and specific capture duct and hood work to capture particulate at these locations. This type of work is beyond the scope of this project because of the details required. This work is also more difficult because sand temperatures can range from ambient to over 300 degrees F. and have moisture contents from 1% through 4%. These conditions create steam problems and unpredictable particulate fall out areas. Dust generation at the molding sand mixer

room is a well-known problem in the foundry industry and there are some possible solutions to reduce it. One solution is to completely enclose mixers or muellers in a cabinet structure and to provide a slight pressurization. The cabinet is then connected to a dry filter dust collector to clean exhaust air stream. The collected material is returned to the mixer as part of the formula. The suggestion of mixing the clay and organic portions with water to provide a slurry and then adding to the mix as a liquid addition greatly reduces dust formed from dry additives and reduces loss of materials. One clay supplier who utilizes this method claims better efficiency of the prewetted clay due to uniform expansion or gel formation of the clay.

4.-4. The extent of miscellaneous metallics such as actual iron castings or part of the offal such as gates and runners in the material to be landfilled is not known. In one instance we observed a dump truck destined to the landfill area containing sand and many iron castings. The simplest method to reclaim these items is to use a rigid screen connected to a pneumatic vibrator to ease separation and flow. More sophisticated applications could provide secondary classification of the sand to remove fines that are undesirable and reduce to overall volume of material dumped. These cases show it is possible to recycle most of the material currently lost after deposit in the land fill. Any reduction in material is an instant saving in fees, transportation costs, and handling costs of collection, labor and tools.

4.-5. The emission from the hood stacks on the Thermos Shock ovens is unknown at this time. Previous situations have shown that carry out from core baking processes did contain regulated materials and corrective actions were needed.

4.-6. The regulation of cupola emissions in the United States was not only directed at the stack emissions but also the water cooling system and the sludge it produced. The sludge in most cases concentrated heavy metals and also would show presence of phenols. Usual analysis report would indicate lead and iron. The cost to dispose of this material often become too prohibitive to continue cupola melting even though the actual emission control during melting was within control limits. For this reason many foundries converted to other forms of melting.

5. COST AND PAYBACK INFORMATION

From the six areas identified and discussed in the report it is important to first reiterate that the costs are not easily determined as all information to make a decision was not available. The cost and payback of a process change and equipment require all critical elements are identified and covered. The work we did in most cases covered only a portion of a problem investigated. However, savings are most assuredly available to Viadrus whenever the amount of material collected for the landfill is reduced. We identified core scrap as a prime target and of considerable value. The amount of scrap cores was estimated at 15 % of daily production. Any reduction will provide payback in both tangible and in tangible terms. These are less disposal fees, less raw material, less production time to many required amount, less energy, less

emissions, longer tooling life, etc. The next area concerns chemical binder systems used to make cores in which some of the components are considered hazardous and regulated. These systems were formulated on these materials such as phenol based and formaldehyde chemistries and cannot easily be changed by reducing the amount components in the formula to make them cleaner. Secondly these systems require large amounts of energy to drive the reaction to completion which in today's technology is not applicable. The need to seriously consider alternative systems is a requirement today. Exchange current binder for more environmental acceptable type that can be utilized with the existing process and equipment. My suggestion would be a for a Warm Box system using a catalyst and a silicon release agent. This system should be able to provide suitable strengths at a lower binder level, require less use of energy to cure, and provide longer bench life in the machine and most important eliminate phenol content and minimize formaldehyde content. A secondary release system may be required to insure core release from the baking operation. Longer term would be to investigate other core making processes and the equipment required to use it and to maintain environmental control. There also exists the probability that the type of products Viadrus makes today will not be continued in the market place. The heating technology of the United States reflects the change from radiator systems to baseboard and central air heating methods.

The next area to minimize waste is basic reclaiming of the current waste stream out of the plant. The potential to reduce the overall amount of sand by screening and classification has tremendous value when the current level of discharge is 20, 000 tonnes annually. Assuming 20 percent sand could be reclaimed , 4000 tonnes are saved or 4000 tonnes of replacement sand do not have to purchased, 4000 tonnes do not have to be land filled, and 4000 tonnes are not charged fees.

The use of cupola melting in the future decade maybe questioned. The process is a pollution generator by design- it works that way. Pollution control is always add-on and does not improve the operation of the melting process. Iron metal melting practices in the United States were altered in the 1970's from cupola melting to different forms of electric melting as a result of environmental control imposed to control fugitive emissions of carbon monoxide and particulate matter containing carbon, iron, sulfur, and silica. The cost to upgrade cupola pollution control equipment was often in excess of new electric melting costs. The advantages of electric melting were less volumes of contaminated air streams and less temperature sensitivity making dry collection and separation very desirable over water based systems and handling the sludge they produced. The single most favorable feature was the elimination of metallurgical coke from the charge make-up. This single factor eliminated metallurgical smoke that is the major pollutant and the most difficult to control. Cupola melting remains a mainstay in large operations melting over 300 tons day; lesser operations have opted to use induction melting furnaces. The manufacturing of metallurgical coke has been sharply reduced in the last decade in the United States as the process also is a pollutant generator producing high volumes of sulfur and carbon particle emissions. Thus future

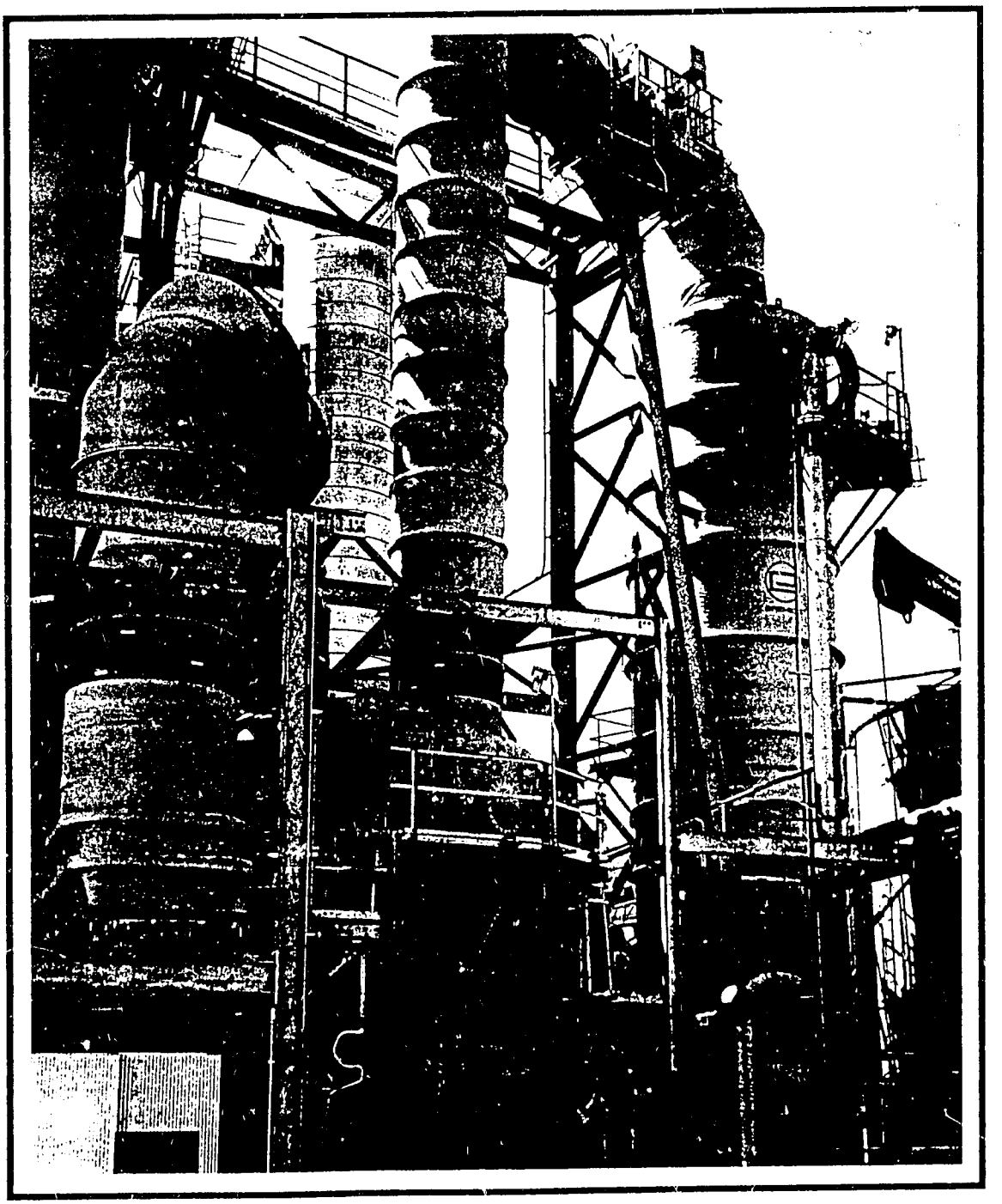
sources of coke are uncertain outside of steel mills that are producers and direct consumers for blast furnace operations.

V. ATTACHMENTS TO

BECK CONSULTING CO. REPORT

DynaWave®

Engineered Scrubbing Systems



Monsanto Enviro-Chem Systems, Inc

Overview

Do you have difficult scrubbing applications that require:

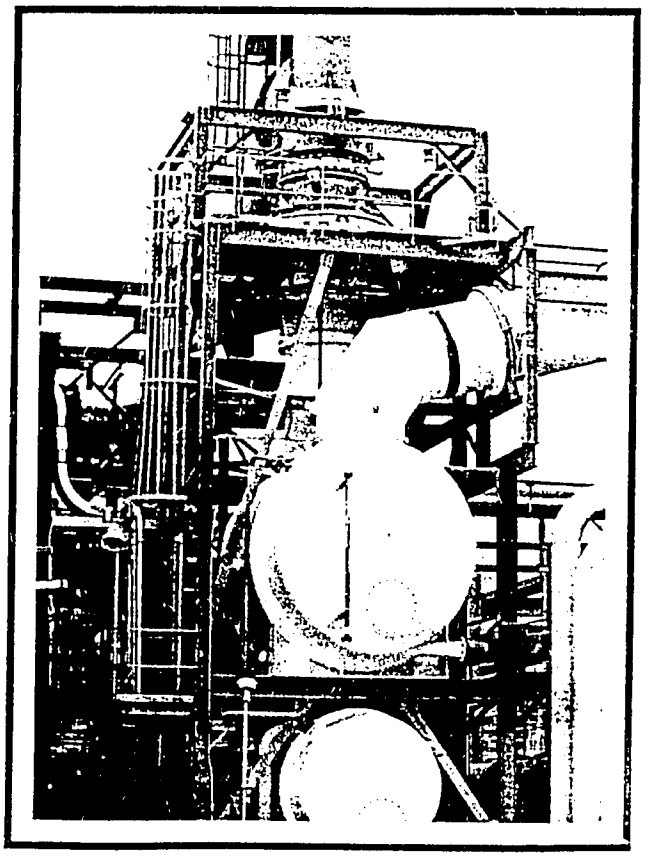
- Cleaning dirty gases that contain high solids loadings
- Cleaning gases that contain sticky solids
- Scrubbing with slurries such as lime or magnesium hydroxide
- Multiple requirements
  - Particulate removal
  - Acid gas absorption
  - Hot gas quenching
- Submicron particulate removal
- High removal efficiencies
- Effluent minimization

DynaWave™ scrubbers were invented specifically to handle these type applications, ones where other scrubbing systems fail.

DynaWave scrubbers utilize Froth Scrubbing Technology. This technology was developed by E.I. Du Pont de Nemours in the 1970's to solve a difficult acid mist and particulate emissions problem. Today, froth scrubbers are used extensively within Du Pont to solve air pollution control problems requiring reliable operation with dirty, hot gases. Over 30 Du Pont plants worldwide have installed over 140 froth scrubbers in more than 40 applications.

Originally, Froth Scrubbing Technology was treated as confidential and not published or made available outside Du Pont. In 1987, Monsanto Enviro-Chem Systems, Inc. entered into a worldwide licensing agreement with Du Pont to design, market and supply the Froth Scrubbing Technology in sulfuric acid, incineration and other industrial gas cleaning/air pollution control applications.

Froth scrubbing is a unique approach to gas scrubbing using extremely high liquid to gas contact which results in highly effective removal of particulate and gaseous components from process and waste streams. The scrubbing principle requires a scrubbing liquid be injected into the gas stream so as to balance the liquid and gas momentums, creating a froth zone through which the gas must pass. The froth zone is a region of extreme gas/liquid turbulence, where intense mixing action produces high rates of heat and mass transfer, and efficient collection of small particles.



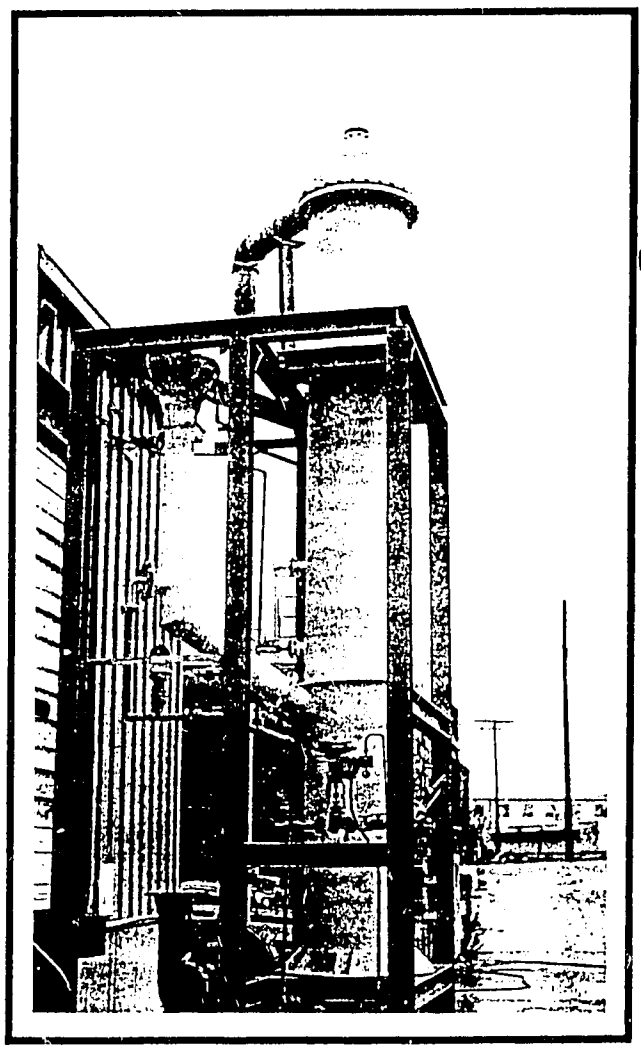
DynaWave scrubbers have several advantages over traditional scrubbing systems.

- **No Plugging**
  - Large, open bore liquid injectors
  - Non-restrictive, open vessels
- **Low Pressure Drop**
  - As low as 1/2 that required by venturi for equal efficiency
- **Broad Turndown Range**
  - 2 : 1 turndown with no loss in efficiency
- **Low Maintenance**
  - No internal moving parts
- **Simple to Operate**
  - Minimal instrumentation
- **High On-Stream Reliability**

DynaWave scrubbers are an excellent fit with tough gas cleaning applications because they are able to operate reliably in dirty environments with high collection efficiencies.The inherently simple design and operation of a DynaWave scrubber is exemplified by the lack of atomizing spray nozzles, narrow passages or moving parts. This results in high on-stream time and low maintenance costs. The ability of DynaWave scrubbers to operate with dirty, sticky, high solids recirculating liquid streams, typically 10% or greater total suspended solids, allows system effluent to be minimized. DynaWave scrubbers can reduce the size of or totally replace electrostatic precipitators, thus minimizing capital and maintenance costs.

Monsanto Enviro-Chem Systems, Inc., a wholly owned subsidiary of Monsanto Company, is a full service Engineering and Construction Company as well as a supplier of proprietary process technologies. These technologies include cogeneration facilities, full scale sulfuric and nitric acid plants, Brink® Mist Eliminators and DynaWave scrubbers.

Monsanto Enviro-Chem has all the necessary engineering, procurement and construction disciplines to design and execute nearly any size project. Projects range from engineering studies or equipment only designs, to full turnkey installations. With our extensive project experience throughout the world, gas cleaning technology can be customized to most plant processes. Experienced personnel are available for interfacing a design with existing processes, as well as providing start up assistance for new or retrofit systems. From custom design through installation, MEC delivers service and technology every step of the way to insure a Total Quality package

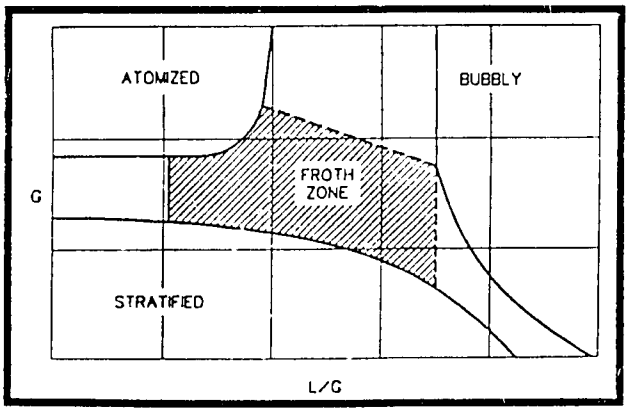


Froth Zone

DynaWave® scrubber technology is based on a unique approach to gas scrubbing that can concurrently accomplish several gas cleaning/processing needs. With this technology, a relatively large volume of scrubbing liquid is injected into the gas stream to establish the froth zone. The froth zone is a region of intense turbulence, with substantial back mixing and a high rate of liquid surface renewal. A proper balance of gas and liquid momentums and liquid to gas ratio is required to set up the froth zone.

The key to design is for liquid and gas velocities to lie within a specific, near flooded region - the froth zone. A two-phase flow regime map was developed to show the region of proper operation. This chart is analogous to a Baker chart describing two-phase flow through a horizontal pipe.

Two-Phase Flow Regime Map



At the lower left of the chart, gas and liquid velocities are both low; gas and liquid are stratified and the liquid surface is calm. As the gas flow is increased, waves begin to form and then their tops are clipped off. At a high enough gas velocity, the liquid is atomized into small droplets. This region is analogous to the operation area of a venturi or other wet scrubbing device which functions via impaction. As the liquid flow is increased, eventually a state in which the gas bubbles through a continuous liquid phase is reached.

The froth zone is a broad flow regime which lies between these boundaries. The boundaries of this region are sufficiently large such that a froth scrubber can easily be designed to operate with 2:1 turndown in gas flow with no loss in scrubbing effectiveness.

DynaWave scrubbers are actually a family of scrubbers, each tailored to address different processing needs. The two main devices are the Reverse Jet scrubber and the Froth Column.

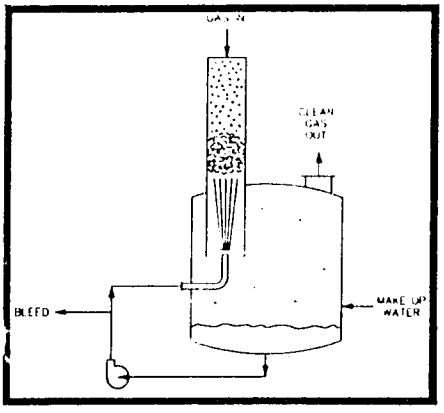
Reverse Jet Scrubber

The Reverse Jet is an annular orifice scrubber, with liquid injected through a non-restrictive opening into a straight-walled barrel countercurrent to the gas flow. The process gas collides with the liquid, forcing the resultant mixture radially outward toward the wall. This creates a high turbulence zone in the region of gas-liquid interface. Flow momentums are balanced and the equipment sized to develop a stable standing wave with intense gas to liquid contact. The wave floats in the gas stream, shifting up or down the barrel, depending upon relative momentums of the liquid and gas streams. Particulate collection, gas absorption and hot gas quenching occur in the froth zone due to gas contact with the large area of constantly renewing liquid surface.

Reverse Jet Scrubbers are extremely reliable with an excellent record of trouble-free operation. Liquid injectors for a typical Reverse Jet sized to handle 50,000 ACFM have openings of 2 inches or larger in diameter. This allows routine operation with 10% or more suspended solids by weight in the recirculating liquid without the threat of

plugging. Also, low liquid effluent rates minimize the load on liquid treatment facilities. High reliability and onstream time are insured by the open, nonrestrictive design of the Reverse Jet Scrubber with no internal moving parts.

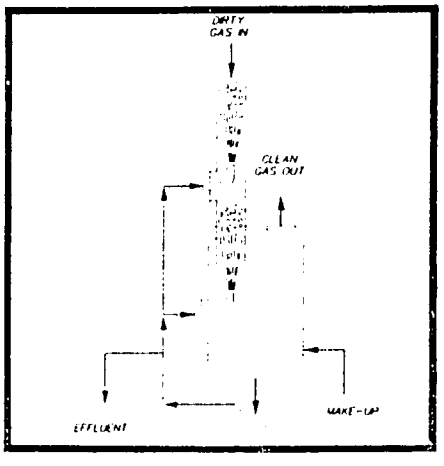
The Reverse Jet can be used alone or in series. The system is simple and easy to operate, requiring minimal instrumentation and operator attention.



Scrubber Systems

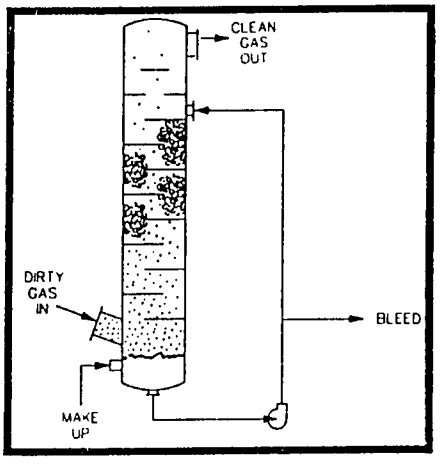
Typical scrubber system designs incorporate more than one stage of DynaWave scrubbing. Staging allows for the optimum use of pressure drop while achieving high particulate and gas contaminant removal efficiencies. A typical system would consist of two Reverse Jets in series installed in one vertical disengagement vessel to remove 90+% of the incoming contaminants and quench the inlet hot gas.

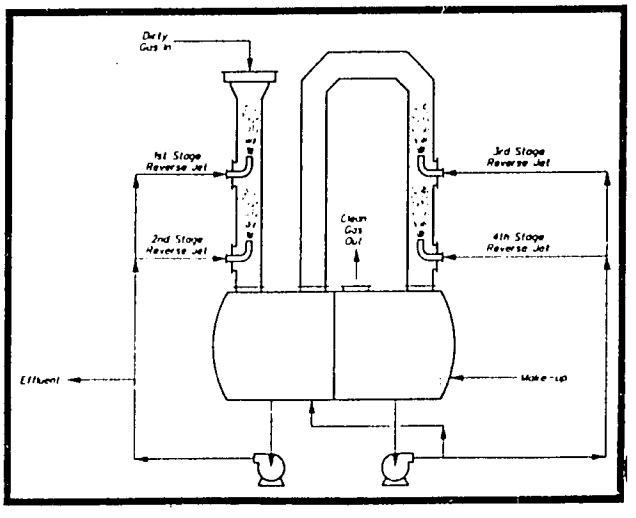
For high performance requirements, four Reverse Jets can be configured in series in one horizontal disengagement vessel to remove 99+% of the incoming contaminants and quench the inlet hot gas.



Froth Column

The Froth Column is similar in appearance to a conventional baffle tray column; however, trays are designed with the optimum open area to induce froth zones in the open areas between the trays. Froth Columns operate with countercurrent gas and liquid flows and are effective at submicron particle removal, gas cooling and multi-stage gas absorption. They are used for cooling or gas absorption in applications where packed columns or sieve trays would be susceptible to pluggage, or where additional collection of particulate is required. The recirculating liquid can be externally cooled and approach temperatures can be controlled to promote particle growth through nuclei condensation, thereby improving particle removal efficiency.





System Design

Fabrication Materials

For most applications, vessels can be constructed of FRP, allowing good chemical resistance at low cost. No field installation of lead or brick lining is needed. Using an innovative wet wall transition, FRP is used to quench hot gases up to 750°F.

The liquid injector is custom fabricated of solid teflon for corrosion and abrasion resistance. For highly abrasive applications, silicon carbide is used.

Monsanto Enviro-Chem will supply DynaWave scrubbers fabricated of FRP, stainless steel or lined steel, depending on the application environment and client specifications.

Pilot Plant

Monsanto Enviro-Chem has three DynaWave pilot plants. These modular units are available to work with our clients in developing custom solutions for unique or difficult scrubbing applications.

The standard pilot plant is designed to handle gas flows up to 700 ACFM at temperatures as high as 700°F. Each pilot plant consists of four modules:

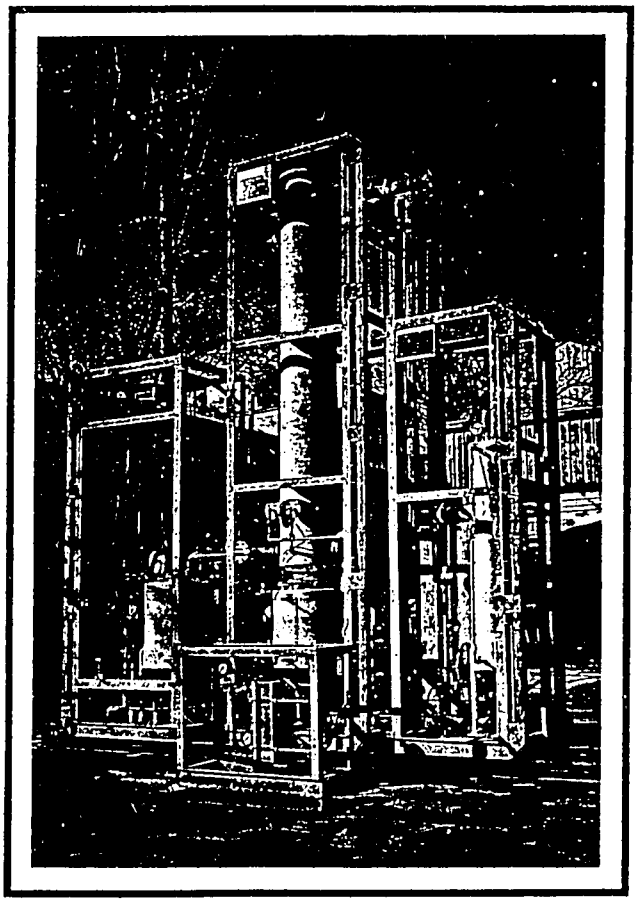
- Reverse Jet
- Froth Column and final Reverse Jet
- Fan and control panel
- Cooler (optional)

All four modules can be shipped on one flat bed truck and reassembled quickly in the field.

When pilot plant tests are needed, Enviro-Chem engineers will work with you to develop an experimental program, properly install the unit and arrange for sampling assistance as needed.

Design Features

- Particulate removal down to 0.008 gr/DSCF
- Gas quenching from 2200°F
- SO_2 removal down to < 10 ppm
- HCl removal down to < 5 ppm
- Low liquid effluent rates
- Dry effluent capability



Monsanto Enviro-Chem Systems, Inc

Monsanto Enviro-Chem Systems
P.O. Box 14547
St. Louis, Missouri 63178 USA

Phone: 314-275-5700
Fax: 314-275-5701
Telex: 989538

Monsanto Europe S.A.
Avenue de Tervuren 270-272
B-1150 Brussels, BELGIUM

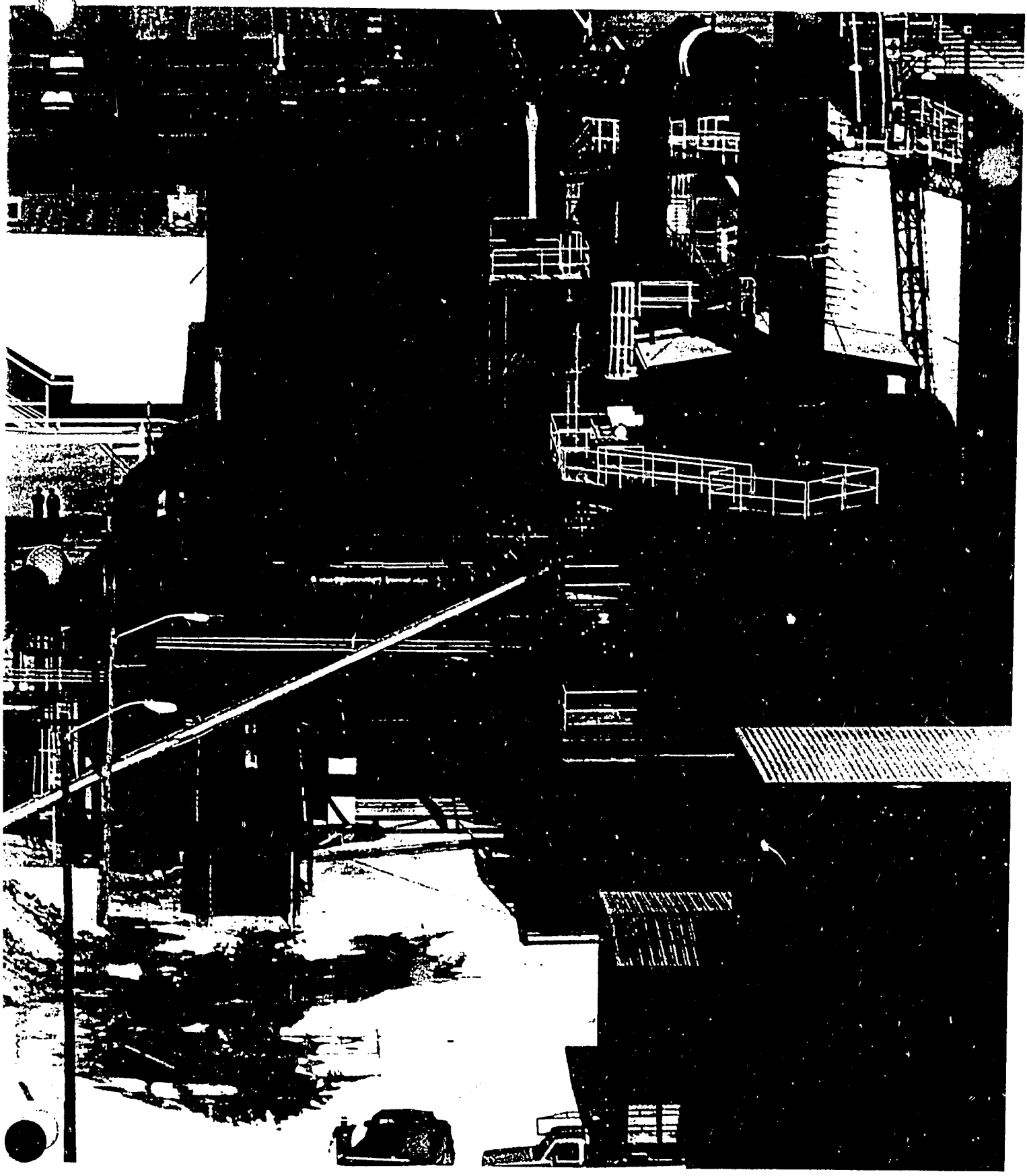
Phone: Int.+32.2.761.46.55
Fax: Int.+32.2.761.40.40
Telex: 62927 MESA B

Monsanto Do Brasil S.A.
Rua Paes Leme, 524
05424 - Sao Paulo, BRASIL

Phone: Int.+55-11-815-0211
Fax: Int.+55-11-211-9922
Telex: (011) 21883 MONS BR

V-2

UNITED MCGILL ELECTROSTATIC PRECIPITATORS



United McGill Corporation

35

United McGill Electrostatic Precipitators

United McGill's electrostatic precipitator (EP) systems provide effective air pollution control for boilers, furnaces, incinerators, and other types of industrial processes. We can design and manufacture an economical system to help you comply with the toughest emissions standards. What sets our EPs apart from conventional designs is a patented high-voltage needle/plate collection electrode for generating the corona current and electrostatic field. In our EPs, a series of sharp needles are mounted along the leading and trailing edges of high-voltage collection plates. The needles produce an electrical charge that causes particulate in the flue gas stream to collect on the electrode plates. This unique design enables our EPs to combine high collection efficiency with the following benefits: low operating costs, low maintenance costs, and small sizes.

Low Operating Costs

All EPs generate a corona current to electrostatically charge particulate and remove it from the flue gas stream. Conventional weighted wire or rigid frame EP designs inherently require large amounts of electricity to collect particulate. United McGill's needle/plate collection electrode design uses energy much more efficiently, enabling our EPs to operate at relatively low levels of voltage and current. By consuming as much as 70 percent less power than conventional precipitators (and far less than baghouses or scrubbers), a typical United McGill EP can save you tens of thousands of dollars per year in electricity costs.

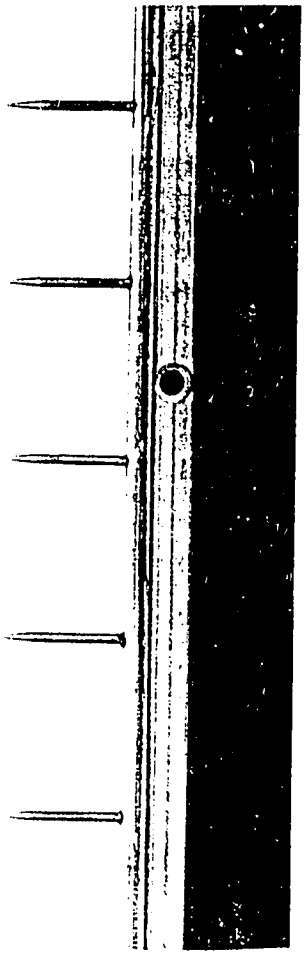
Low Maintenance Costs

EPs are equipped with rapping systems that periodically clean particulate from the collection surfaces. Because our EPs generate a high average current density, the electrodes do not require the frequent cleaning that conventional corona electrodes need. Less frequent rapping means less wear and tear for the EP internals. The potential for damage to the corona-generating needles is further reduced because of the rigid support provided by the plates. In addition, operating at low voltage and current helps prolong the life of our EP insulators. The overall result is reduced maintenance requirements and costs.

Small Sizes

The collection surfaces in a United McGill EP consist of parallel rows of high-voltage and grounded collection plates arranged in alternating order. Both types of plates are charged with opposite polarities and spaced closer together than the single-polarity plates in conventional EPs. Because of the compact design, our EPs are physically smaller than conventional units, making them a better choice for installations where space is limited.

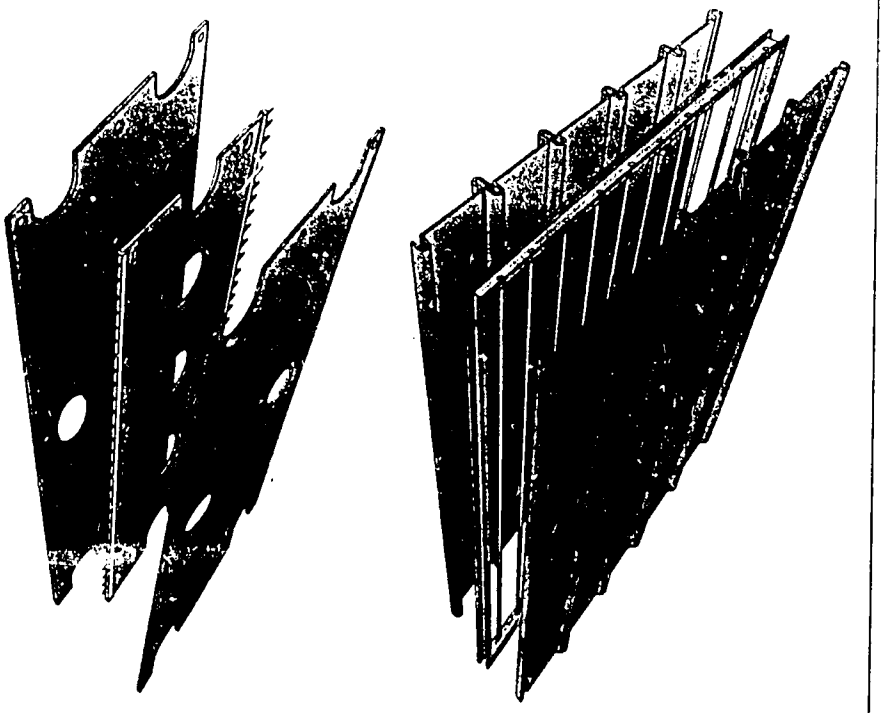
Cover: Three United McGill EP systems control glass furnace emissions. Each system has ductwork, evaporative cooler, electrostatic precipitator, induced draft fan, and exhaust stack.



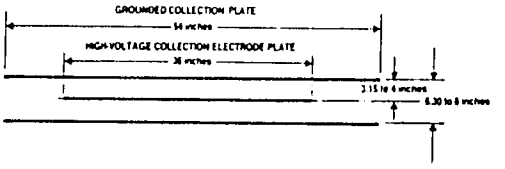
A scale view of a section of needle electrodes mounted on the edge of a high-voltage collection electrode plate.

A scale view of the same needle electrodes under normal applied DC voltage. Corona current flows from the needle tips through the gas stream to a resistive layer on the grounded collection electrode.

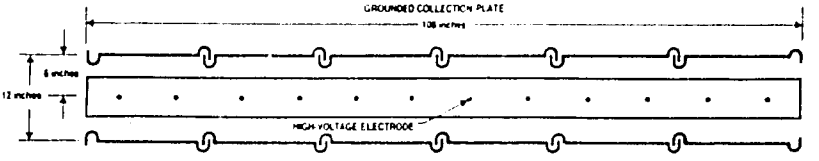
© Copyright 1995 United McGill Corporation—All Rights Reserved



Artist's renderings, approximately to scale, showing the internals of a United McGill EP (left) and another type of EP (right). Note the rigid frame electrodes compared with United McGill's needle/plate design

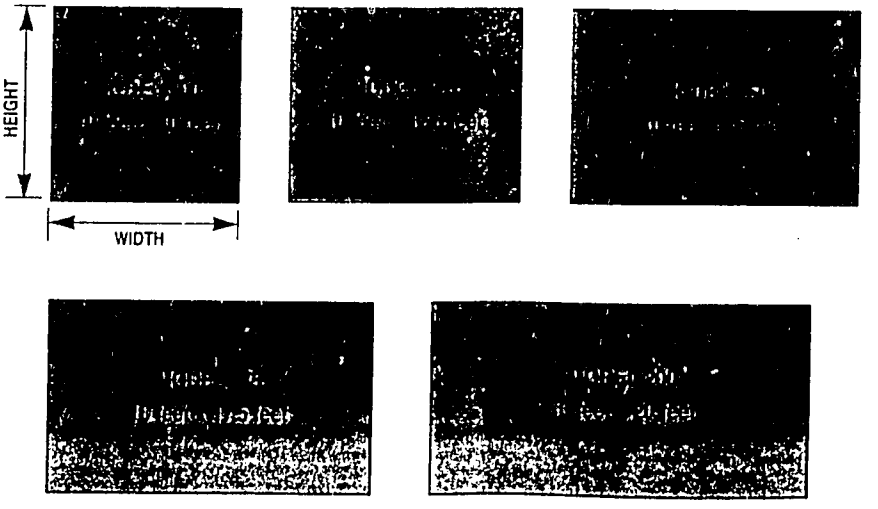


Plan view of United McGill EP electrodes with typical dimensions.



Plan view of the electrodes from another type of EP with typical dimensions.

Module Sizes (height x width)



Modular Construction

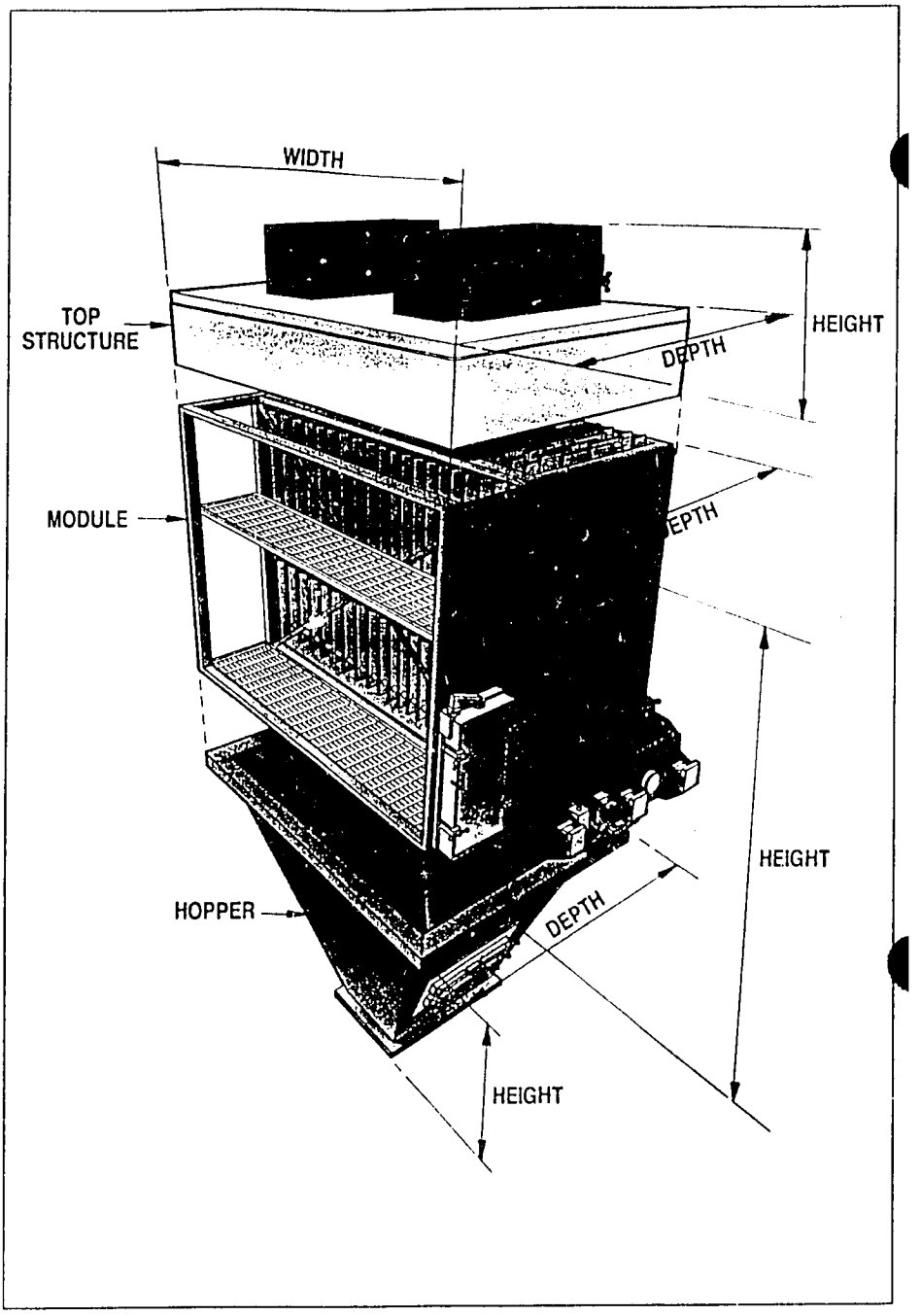
United McGill EPs are constructed of individual modules. Using these modular building blocks, we can provide a broad range of EP sizes. This modular concept enables us to match your needs accurately, so that the EP we provide is the right size and price for your application. A modular design is practical for our EPs because of the high-voltage needle/plate collection electrodes and compact size. It is impractical for conventional EPs with their large, fragile electrodes.

All of our EP modules are about 10 feet high by 8 feet in depth. Nothing else changes but the width. Components such as rapping devices and insulators remain the same. Each module is self-supporting, requiring no external structural frame. The internal structure serves as both the main shipping frame and the permanent frame for supporting the high-voltage and grounded collection electrode plates. This internal structure also provides a smooth surface to insulate, minimizing cold spots and differential thermal expansion.

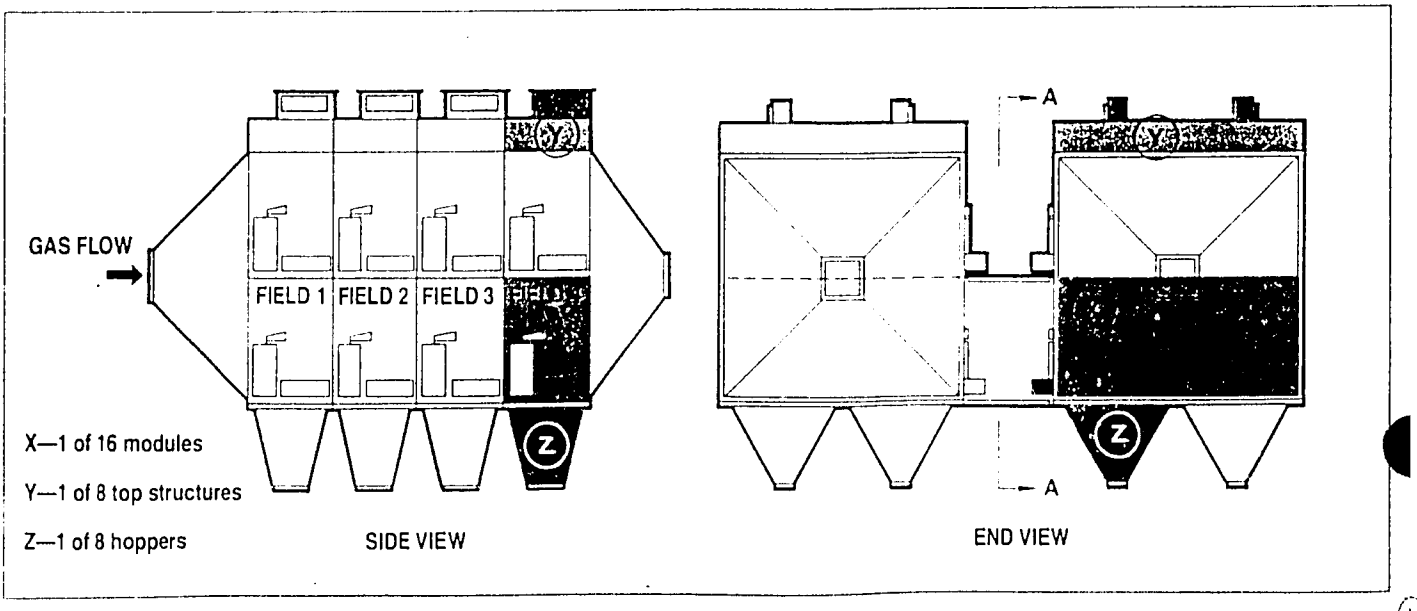
Module Size

The five module sizes pictured in the figure to the left are used to build United McGill's field-assembled EPs. Small pre-assembled EPs are available, using Model 25, 50, and 75 modules (7.5 feet high).

Drawing of a basic EP module with top structure and hopper.



Two views of a United McGill Model 4-350 x 2 EP with 16 Model 175 modules, 8 top structures, 16 rapping subassemblies, 16 side access doors, and 8 hoppers, in two chambers.



Standard Designs

Modular construction means standard designs with consistent quality and lower manufacturing costs. We have a standard design for virtually all EP components: EP modules with rapping and access doors, top structures with insulators, hoppers, horizontal support structures, access platforms, and stairs. The only items that are not always standard are the vertical support structure and the inlet and outlet transitions for connecting the EP to the rest of the air pollution control system, which often must vary from site to site.

A simplified drawing of United McGill's EP design, shown from the top down, depicting both traveling-hammer and pneumatically actuated rapping systems:

A. Support insulators for the high-voltage collection plates

B. Adjustable hanging frame for the high-voltage collection plates

C. High-voltage needle/plate collection electrode

D. Grounded collection plates

E. Spacers for the collection plates

Traveling-Hammer Rapping

F. Stationary support insulator—high voltage

G. Traveling insulator—high voltage

H. Electric drive motor

I. Machine screw drive

J. Insulator enclosure heater

K. Hammer rapper for grounded collection plates

L. Hammer rapper for high-voltage collection plates

M. Rapping/insulator enclosure, internally insulated with key-interlocked access door

Pneumatically Actuated, Positive-Displacement Rapping

N. Rapping/insulator enclosure, internally insulated

O. Insulator/rapping mechanism assembly for rapping high-voltage collection plates

P. Pneumatic cylinders for rapping grounded collection plates

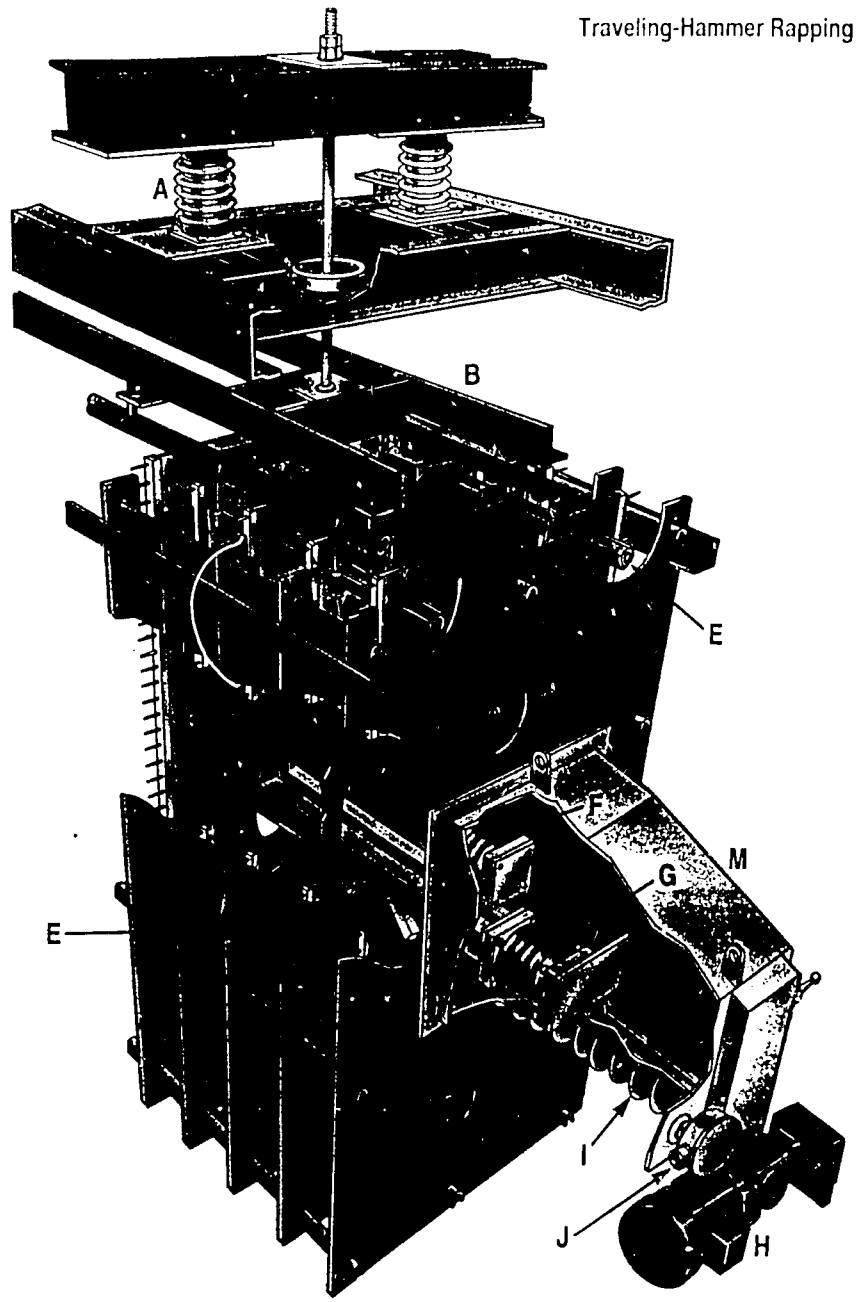
Q. Insulator enclosure heater

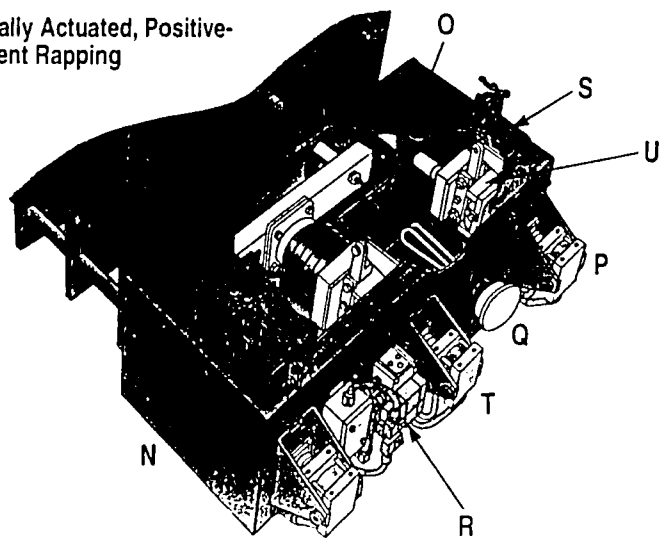
R. Solenoid valves

S. Key-interlocked access door

T. Pneumatic cylinder for rapping high-voltage collection plates

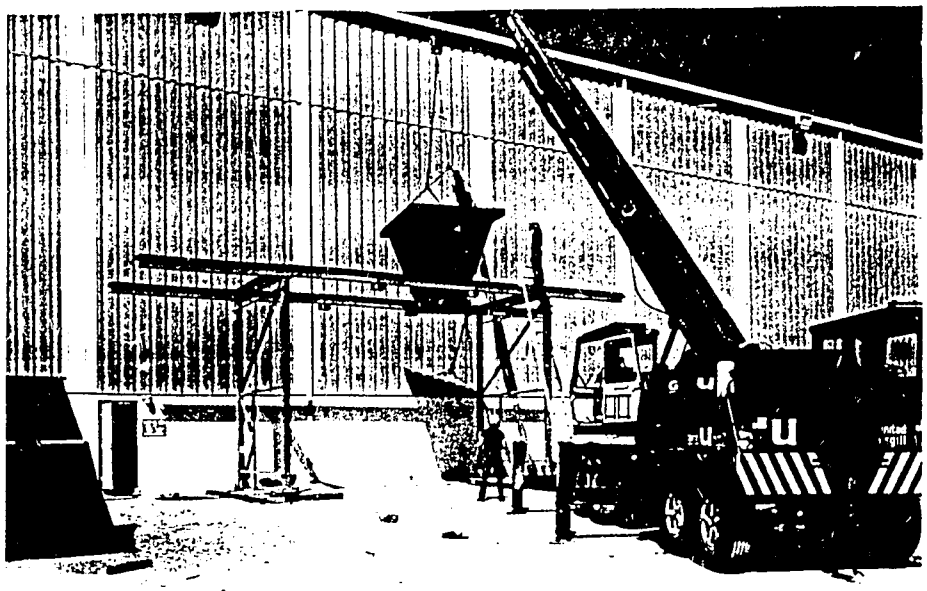
U. Rapping mechanism assembly for grounded collection plates (typical)

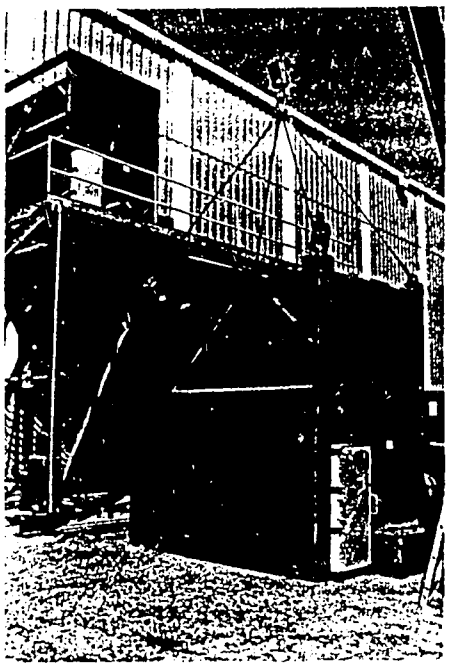




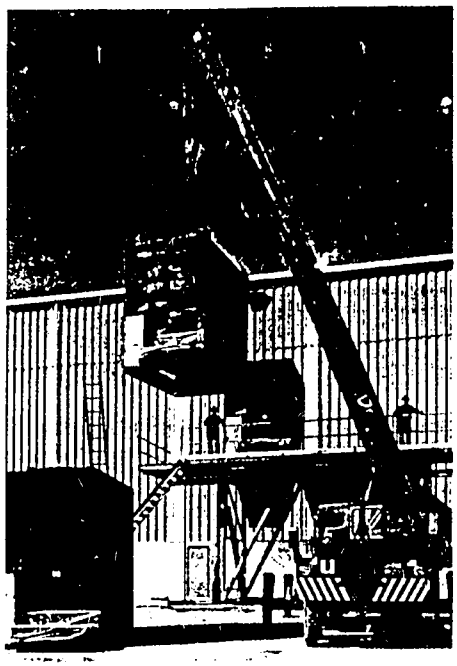
Low Construction Costs

Modular design minimizes expensive field construction because as much of the work as possible is done in our manufacturing plant. We manufacture complete modules and ship them to the jobsite for installation. Conventional EPs are assembled piece by piece in the field, often making installation costs as high as the cost of the equipment itself. United McGill's modular EP design reduces installation costs and makes it practical to add to or move an EP if future changes require it.

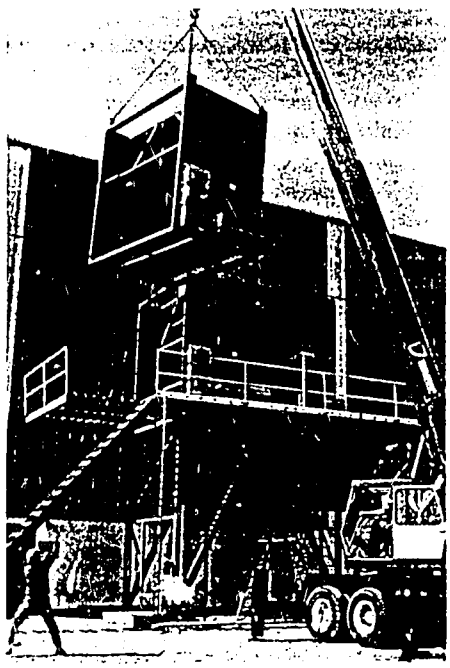




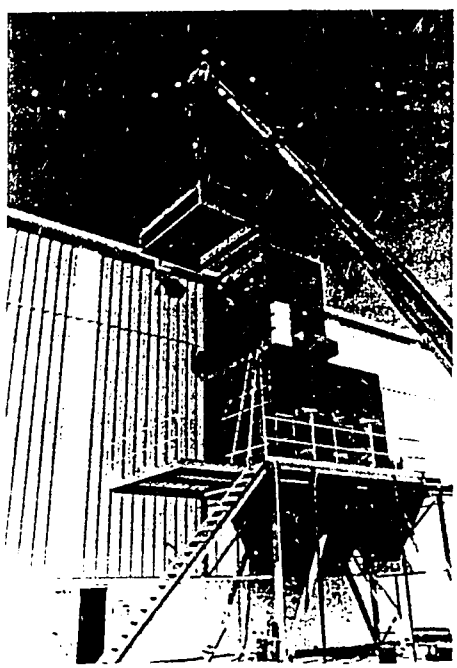
2



3



4



6

Installation of United McGill's Modular Electrostatic Precipitator

1. Setting up one of three hoppers for a Model 3-200 EP.

2. Rigging a Model 100 EP module, a 12,400-pound lift.

3. Lifting the second Model 100 module, the bottom part of the second field.

4. Lifting the third of six modules. Only a very small crew is required to erect any size precipitator.

5. Setting up the top structure for the first field, a 4,700-pound lift.

6. Inlet transition is in place ahead of first EP field. Transitions can also be designed for top, bottom, and side entry.

Control Systems

To make our EP systems easy to operate and maintain, we supply powerful PC-SAM computerized control systems. Each control system combines a programmable logic controller (PLC) with a personal computer (PC). United McGill has extensive experience using PLCs to operate emissions control equipment. By adding a PC to the control system package, we give you simplified control, programming flexibility, and greater data acquisition with historical trending capabilities.

Simplified Control

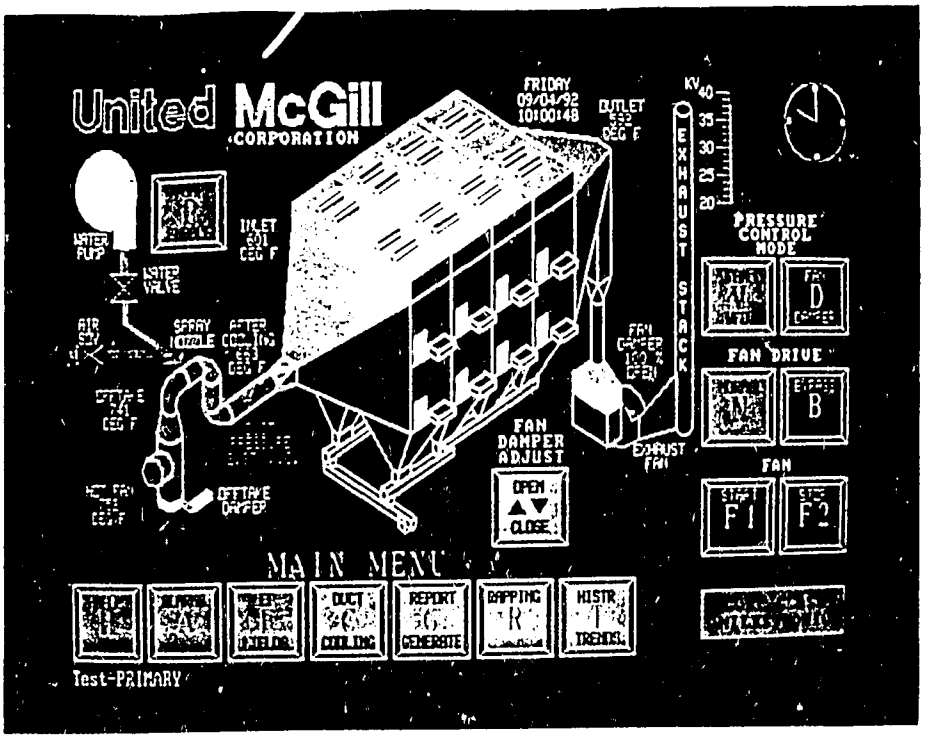
The PLC is the brains of the control system, making decisions about the day-to-day operations of your air pollution control equipment. The PC puts control of all functions at your fingertips, while providing visual displays so you can monitor operations. Our PC-SAM control system is user friendly and can be set up for on-site or remote control. The PC can be programmed to work with controls for the precipitator and subsystems of your process, giving you a single integrated system.

Programming Flexibility

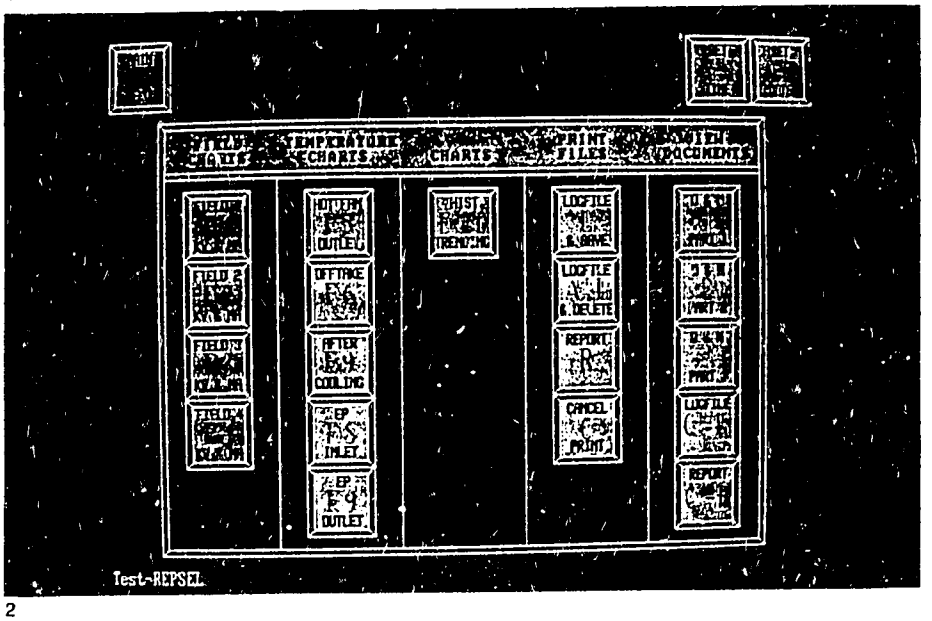
Because emissions control needs can change over time, we design our PC-SAM software so that it can be reprogrammed quickly and easily. This control flexibility helps keep your emissions control equipment operating effectively, while working with our optional energy management systems to minimize your operating costs.

Data Acquisition

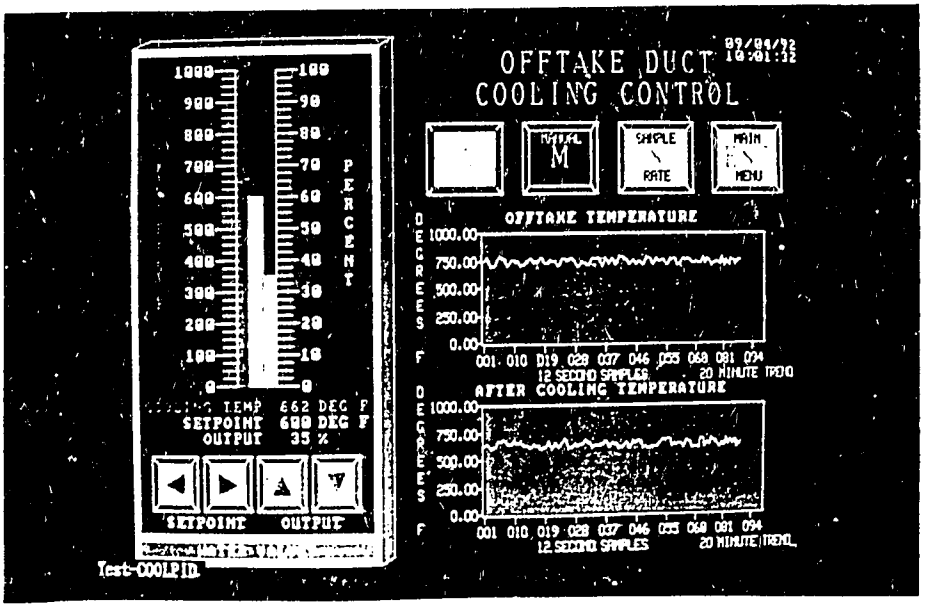
The PC records operations data such as temperature, pressure, gas flow, emissions levels, voltage, current, opacity versus power, and voltage versus rapping cycle. Data can be stored for up to 6 months and can be used to show trends in the EP system's operation, helping you monitor performance and diagnose potential problems.



1



2



3

1. PC-SAM's control screen provides user-friendly access to the precipitator system's control functions.

2. The PC-SAM control system has extensive report and trending capabilities including on-screen operating and maintenance manuals.

3. Adjustments to the precipitator's subsystems can be easily and quickly made with a few keystrokes.

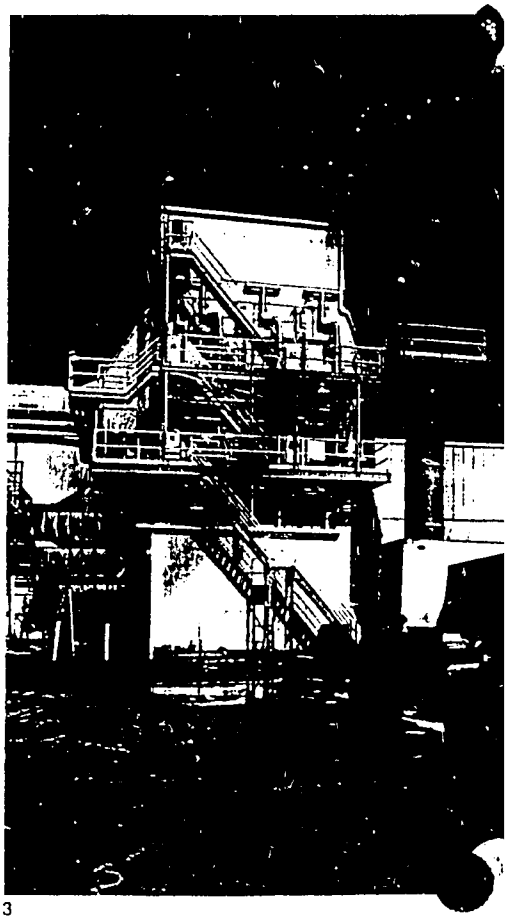
APPLICATIONS

United McGill has solved air pollution control problems for a wide range of applications. In addition to our standard EP systems, we provide wet EPs to control process emissions that contain organic compounds, fine particulate, sticky materials, or combustible materials. Our wet EPs use water to condense organic emissions so that the EP can collect them. A wash system helps prevent fires by cleaning sticky and combustible particulate from the collection electrodes.

For emissions that contain acid gases, we provide spray-dry scrubbers and dry reagent injection systems. Both are complete pretreatment systems for converting gaseous pollutants to solid materials that can be collected by an EP. Over the years, we have provided effective control of acid gases such as hydrogen chloride, sulfur dioxide, hydrogen fluoride, and boric acid.

1

2

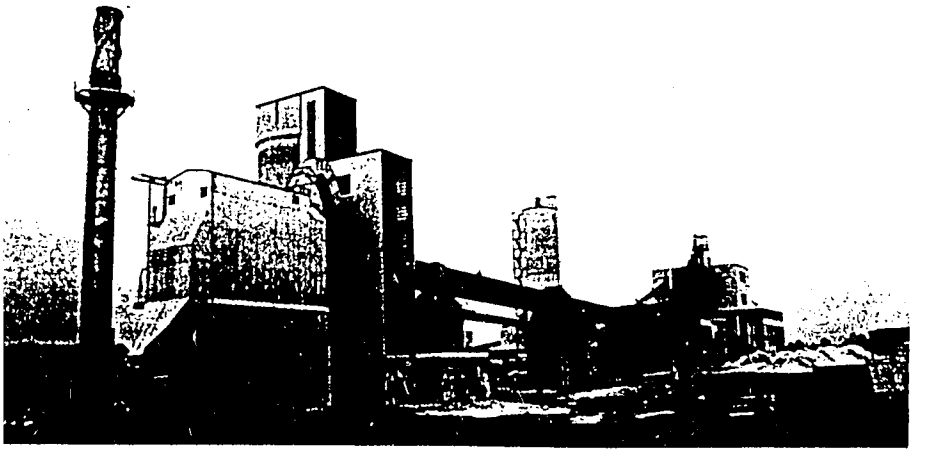


3

1. United McGill installed three spray-dry scrubbers, two electrostatic precipitators, and a fabric filter to control acid gas and particulate emissions from this mass-fired municipal solid waste incinerator located in North Carolina.

2. A United McGill EP system with four chambers (Model 5-600 x 4) collecting approximately 40 tons of iron oxide per day from two basic oxygen furnace vessels in Colorado.

3. Using a United McGill Model 3-500 wet EP, this facility meets the EPA's most recent air pollution control standards for fiberglass forming and curing.

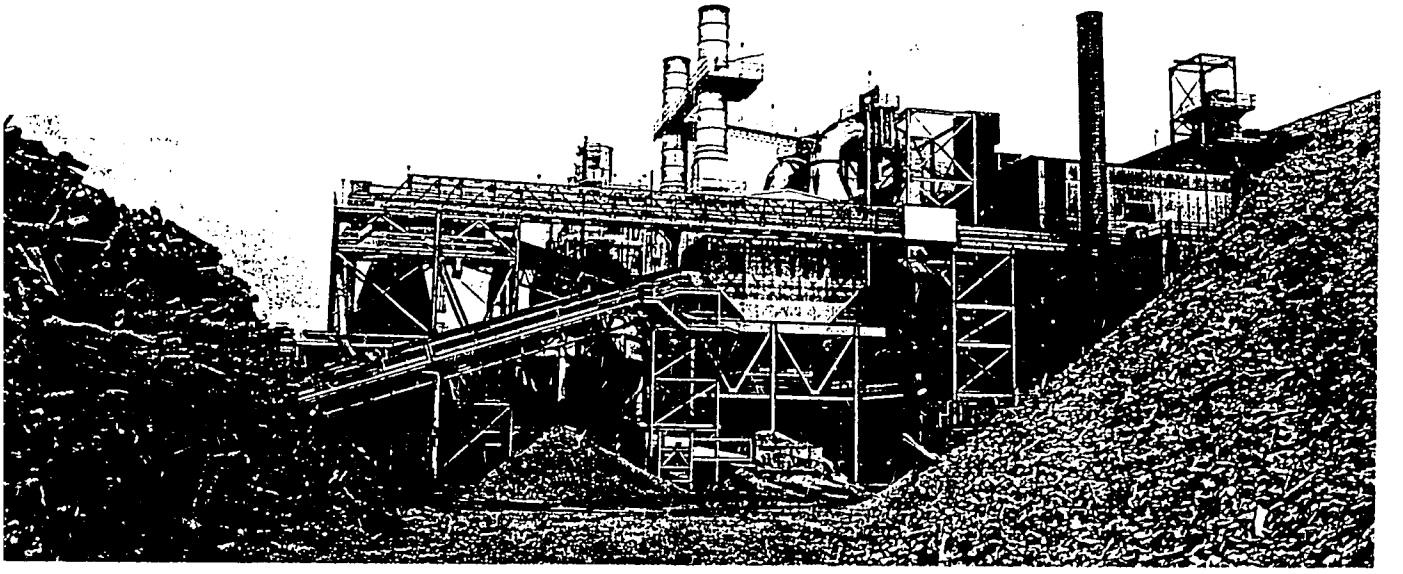


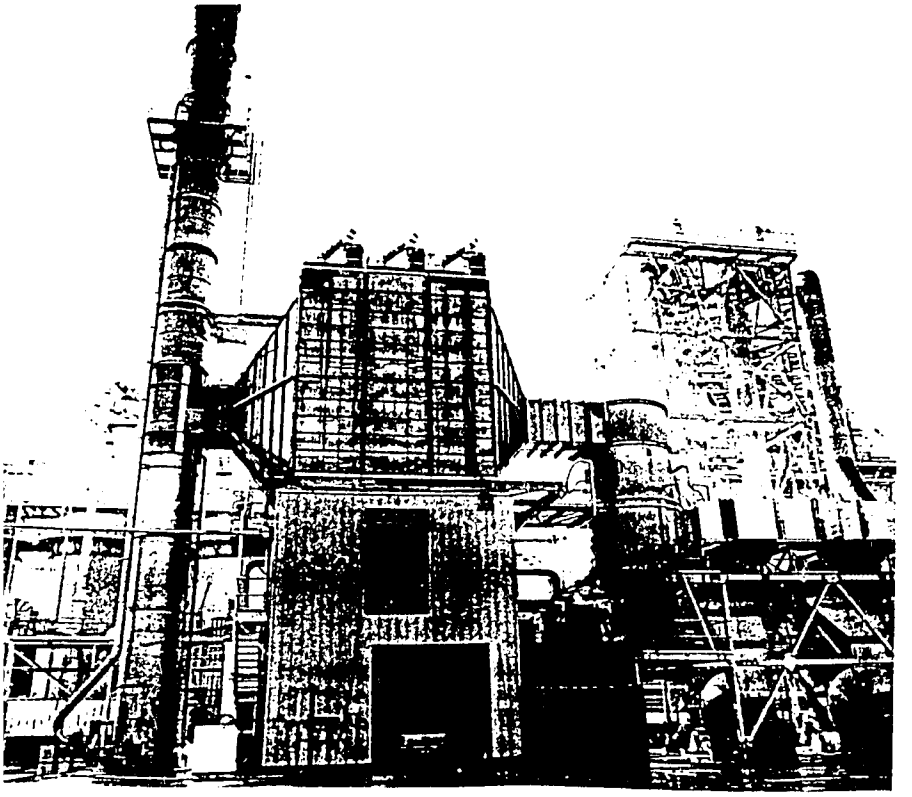
4. A United McGill Model 5-300 EP collecting calcium oxide from a cement plant's dry process kiln in Ontario, Canada.

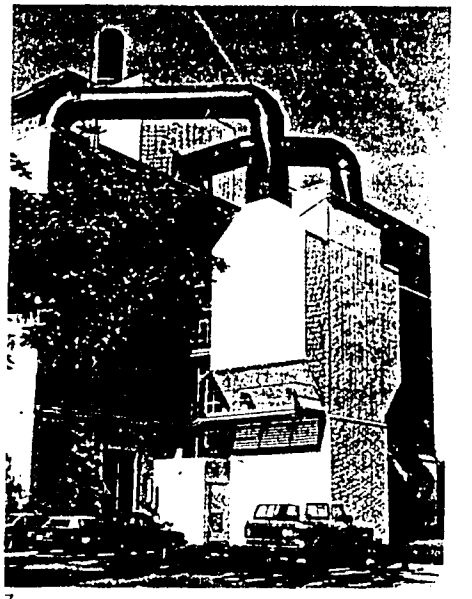
5. The flyash produced by a combination-fueled boiler (coal and bark) for an Alabama packaging manufacturer is collected by a United McGill Model 3-500 x 2 EP.

6. Emissions from three wood dryers are collected by United McGill's Model 3-600 wet EP. It has a cross-sectional area of 600 sq ft and handles a volume flow of 160,000 acfm.

7. Flyash from two coal-fired boilers providing steam for an Ohio university's power plant is controlled by a United McGill Model 2-300 EP.







7

Complete Turnkey Service

United McGill can supply complete air pollution control systems, working with you at every stage of a project to solve your problem. We can start by using our mobile testing equipment to analyze your emissions and size a full-scale system for your application. If both particulate and acid gas emissions need to be controlled, we can supply a system that combines an EP with a spray-dry scrubber or dry reagent injection. We can handle construction of your EP system, supplying all the necessary equipment. Once installation has been completed, we will work with you to make sure you continue to meet emissions regulations for years to come.

Auxiliary Equipment

We can handle your entire air pollution control project, supplying equipment such as the following:

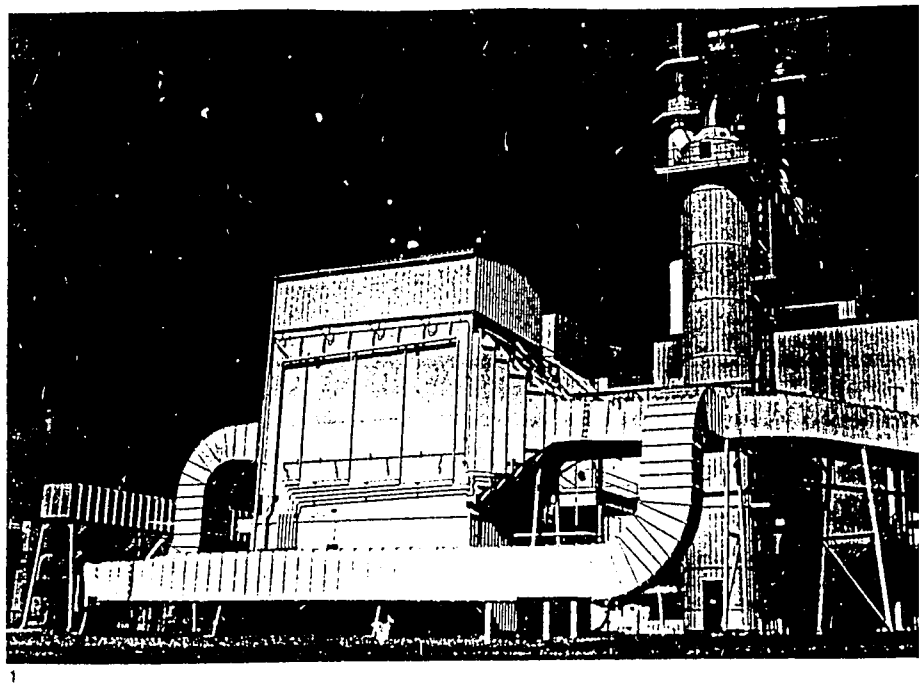
Particulate Control
- Electrostatic Precipitators (wet or dry)
- Fabric Filters

Acid Gas Control
- Reagent Storage (wet or dry)
- Reagent Preparation
- Reagent Transport (wet or dry)
- Spray-Dry Scrubbers
- Reaction Chambers

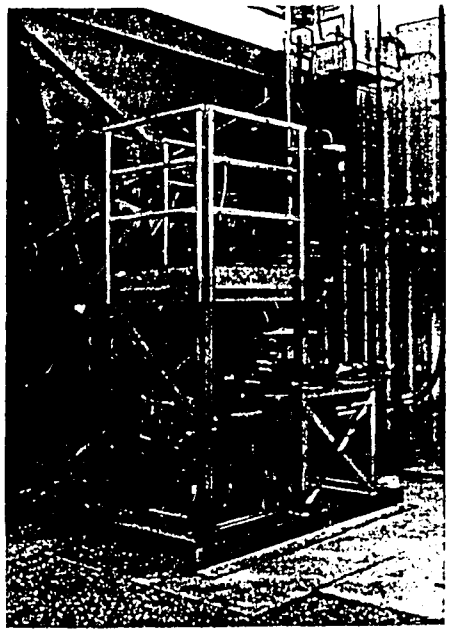
Control of Volatile Organic Compounds (VOCs)
- Regenerative Thermal Oxidizers

Evaporative Coolers
- Up Flow
- Down Flow
- In Duct

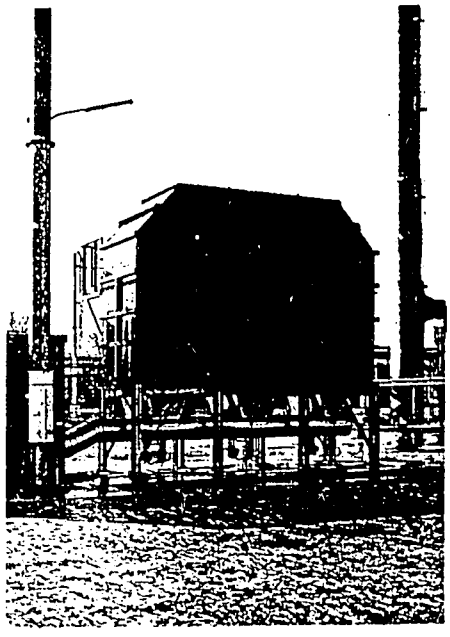
Auxiliary Equipment
- Recycling Systems
- Disposal Systems
- Stacks
- Control Systems



1



2



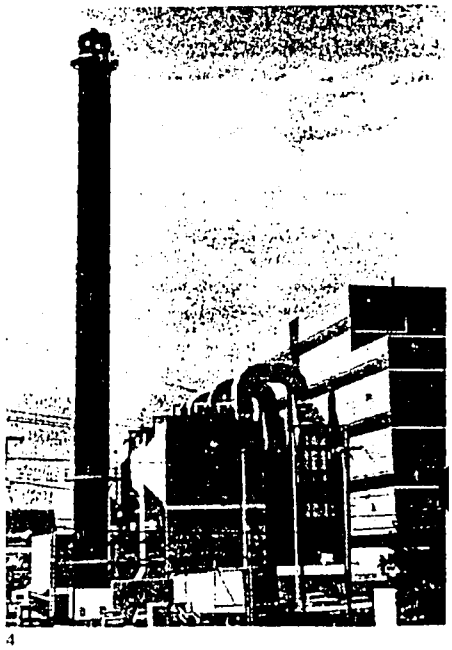
3

1. United McGill combined a spray-dry scrubber, dry EP, and two wet EPs to provide complete air pollution control for this California fiberglass plant.

2. For small-scale applications, we offer skid-mounted dry reagent feed systems that are factory assembled for quick installation.

3. United McGill's ThermaGrid™ regenerative thermal oxidizers (RTOs) control volatile organic compounds (VOCs) for a variety of applications and industries at substantial energy savings over other types of thermal oxidizers.

4. The design, fabrication, and erection of a three-flue exhaust stack, 12 feet in diameter by 210 feet high, was part of this 4-350 x 3 EP system for an Alexandria, Virginia, municipal solid waste facility.



4

Emissions Testing

United McGill provides testing services to analyze your emissions problem and develop an effective solution. Our mobile testing equipment includes two EPs that can operate wet or dry, a spray-dry scrubber, a quench tower, and a water filtration and recirculation system. With a few weeks of testing, we can collect enough data to size a full-scale EP system and verify that it will meet your emissions control requirements. Tests are conducted at a realistic volume flow of approximately 5,000 to 10,000 actual cubic feet per minute.

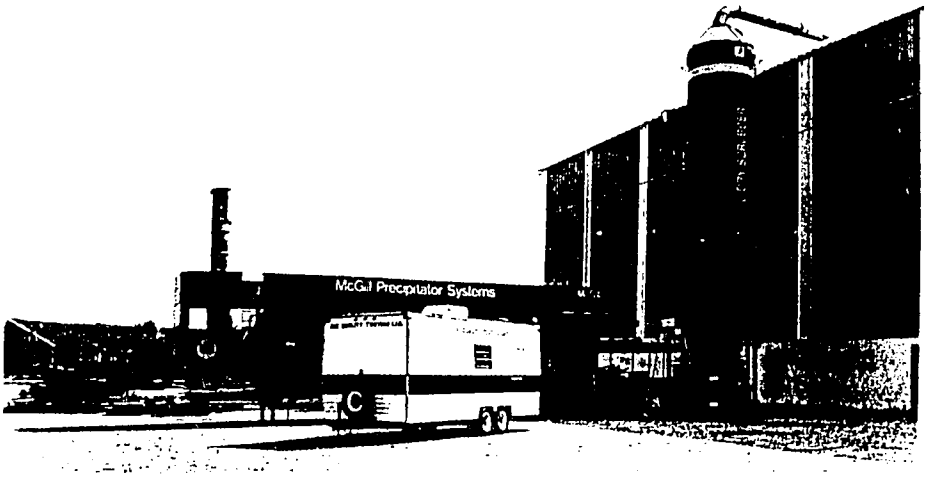
Our technical staff can provide Environmental Protection Agency stack testing for emissions quantities at the inlet and outlet. Results can be evaluated quickly during the program in case operating condition changes are required. Other tests conducted include particle size measurements, gas analysis, and opacity monitoring. Chemical and resistivity analyses of the collected dust are done separately to predict how the full-scale precipitator will perform at temperatures and moisture levels different from those encountered during the mobile EP testing.

Computer-optimized, experimental design techniques are often used to establish the most useful series of tests. A detailed technical report is provided soon after the testing program has been completed.

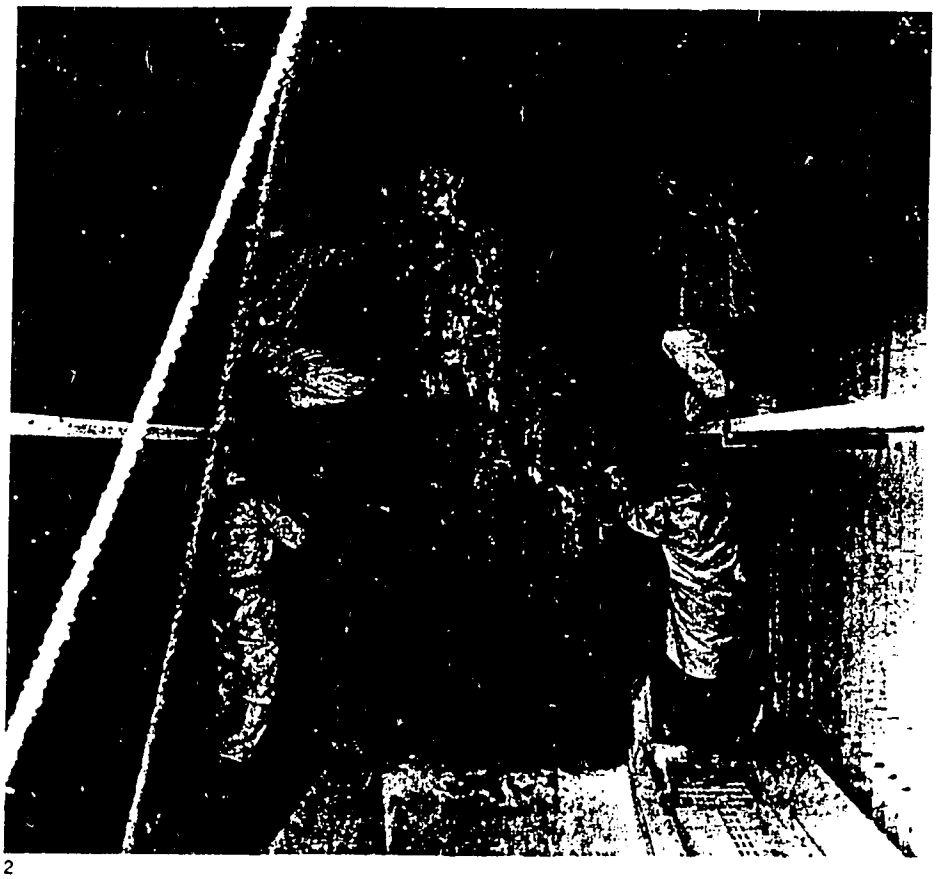
Repair and Maintenance

United McGill has a complete service program to maintain, repair, upgrade, and rebuild EP systems. We provide emergency repair service in case a problem with your EP forces you to shut down. Our technicians diagnose problems and solve them to get you back on line quickly. Many high-demand replacement parts are stocked and can be shipped immediately.

To prevent problems from becoming emergencies, we can provide periodic inspections and preventive maintenance that meets your schedule. We rebuild and upgrade EP systems if performance is affected by process changes or wear and tear. We also upgrade systems with the latest technology to improve performance and reduce operating costs.



1



2

1. A mobile EP and spray-dry scrubber can be used to test emissions and analyze your control needs.

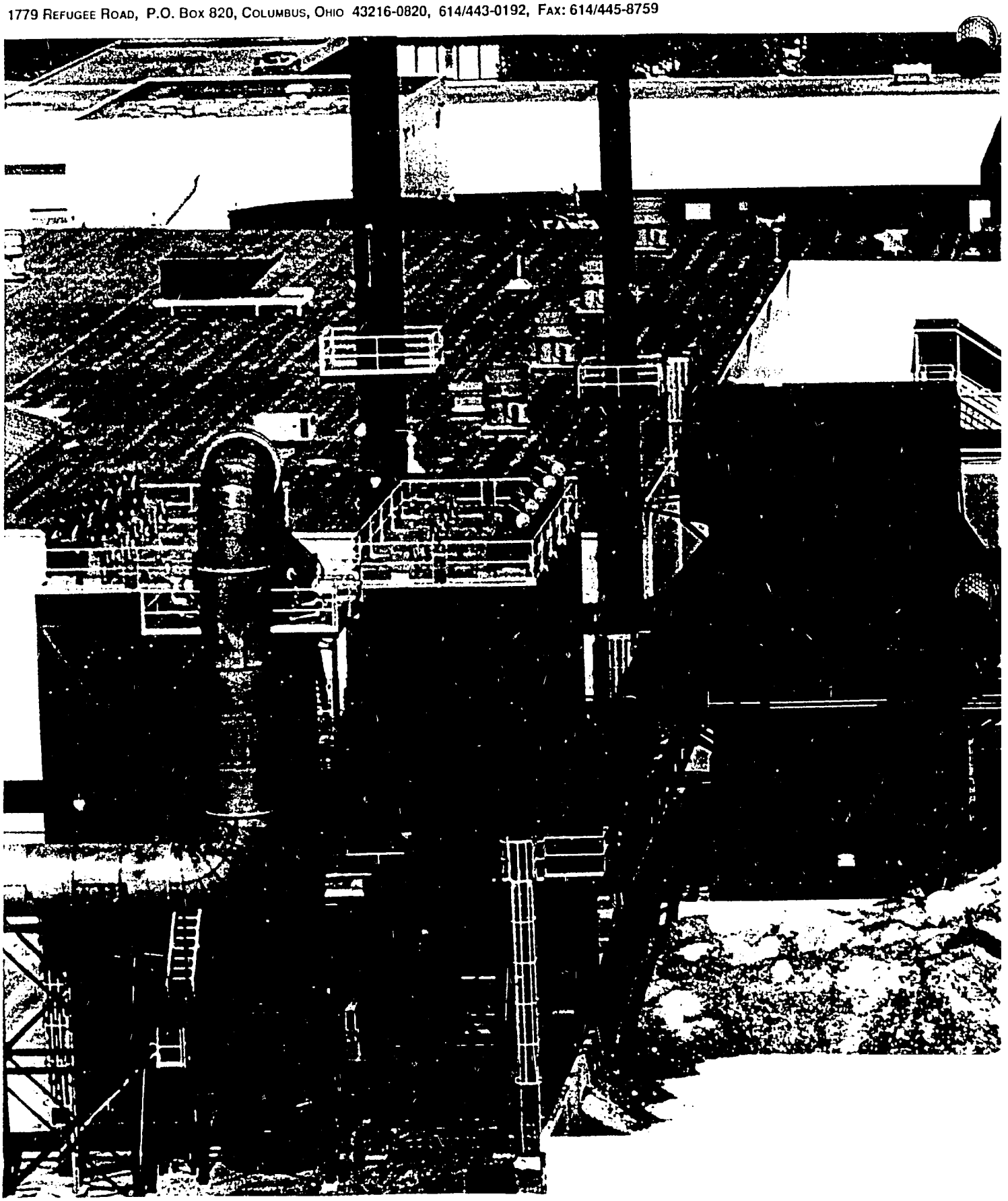
2. United McGill can rebuild or upgrade older equipment. Technicians are shown here at work on a project that included rebuilding the EP's internals and installing a new rapping system.

3. We can inspect your EP on a scheduled basis to locate and solve potential problems.

United McGill Corporation products depicted in this brochure were current at the time of publication. As a quality-conscious manufacturer, United McGill is constantly seeking ways to improve its products to better serve its customers. Therefore, all designs, specifications, and product features are subject to change without notice.

United McGill
Corporation

1779 Refugee Road, P.O. Box 820, Columbus, Ohio 43216-0820, 614/443-0192, Fax: 614/445-8759



VI. ATTACHMENTS TO G. WANDTKE REPORT

VI-1

ŽDB a. s., závod topenářské techniky VIADRUS

VI-1

Ing. Zdeněk Churý
ředitel závodu Director

ŽDB a. s., BOHUMÍN
závod topenářské techniky VIADRUS
Bezručova 300, 735 93 Bohumín

Tel: (06992) 821 00
Fax: (06992) 33 74
Telex: 522 33, 521 93

ŽDB a. s., závod topenářské techniky VIADRUS

Ing. Ladislav Rosman
vedoucí technického úseku
Foundry Technical Manager

ŽDB a. s., BOHUMÍN
závod topenářské techniky VIADRUS
Bezručova 300, 735 93 Bohumín

Tel.: (06992) 8 31 41
Fax: (06992) 33 74

ŽDB a. s., závod topenářské techniky VIADRUS

Ing. Rudolf Šalbut
vedoucí provozu slévárna kotlů
Foundry Manager

ŽDB a. s., BOHUMÍN
závod topenářské techniky VIADRUS
Bezručova 300, 735 93 Bohumín

Tel.: (06992) 8 22 18
Fax: (06992) 33 74

ŽDB a. s., závod topenářské techniky VIADRUS

Eduard Kuřil
technolog
Boiler Foundry Melting Superintendent

ŽDB a. s., BOHUMÍN
závod topenářské techniky VIADRUS
Bezručova 300, 735 93 Bohumín

Tel.: (06992) 8 22 48
Fax: (06992) 33 74

ŽDB a. s., závod topenářské techniky VIADRUS

Ing. Josef Balhar
technolog
Foundry Process Engineer

ŽDB a. s., BOHUMÍN
závod topenářské techniky VIADRUS
Bezručova 300, 735 93 Bohumín

Tel.: (06992) 8 23 55
Fax: (06992) 33 74

ŽDB a.s. ZÁVOD SLÉVÁRNY

Ing. Vladimír VOLF
vedoucí technolog
Foundry Engineering Manager

735 93 Bohumín
Bezručova 300

tel. 06992|82438
fax. 06992|3374

ŽDB a. s., závod topenářské techniky VIADRUS

Ing. Pavel Bury
vedoucí technického rozvoje
Foundry Project Engineering Manager

ŽDB a. s., BOHUMÍN
závod topenářské techniky VIADRUS
Bezručova 300, 735 93 Bohumín

Tel.: (06992) 8 27 78
Fax: (06992) 33 74

Ing. IVO DOSTÁL
Quality Control Engineering Manager

Železárny a drátovny,
Bezručova 300
735 93 Bohumín
Tel. 21 51, 32 51, kl. 32 40
Telex 522 33, 521 93

Adresa bydliště:
Bož. Němcové 679
735 81 Bohumín

World Environment Center
Prague Office

LUDMILA HOFMANOVA
OFFICE MANAGER

WORLD ENVIRONMENT CENTER
419 PARK AVENUE SOUTH
SUITE 1800
NEW YORK, N. Y. 10016
TEL. (212) 683-4700
FAX (212) 683-5053

PRAGUE OFFICE:
110 00 PRAHA 1
POLITICKYCH VEZNU 13
CZECH REPUBLIK
TEL.: +42-2-242 11 772
FAX: +42-2-242 15 295

WILLIAM B. BECK PE

BECK CONSULTING
"Putting Value Into Environmental Consulting"

3123 Greenwood Glen Dr
Kingwood TX 77345

Ph (713) 360-7023

GOOD ECONOMIC SYSTEM, spol. s r. o.
Havlíčkovo nábřeží 38, OSTRAVA

Ing. Pavel MAREK
specialista
Ekologické řízení a ekoaudit firem

Telefon: 069/626 43 08
069/626 40 64
Tel./fax: 069/22 14 48
069/626 43 09

Korespondenční adresa:
GES, spol. s r. o.
P. O. BOX 294
729 94 OSTRAVA

GOOD ECONOMIC SYSTEM, spol. s r. o.
Havlíčkovo nábřeží 38, OSTRAVA

Ing. Gustav WIECZOREK
president

Telefon: 069/626 43 08
069/626 40 64
Tel./fax: 069/22 14 48
069/626 43 09

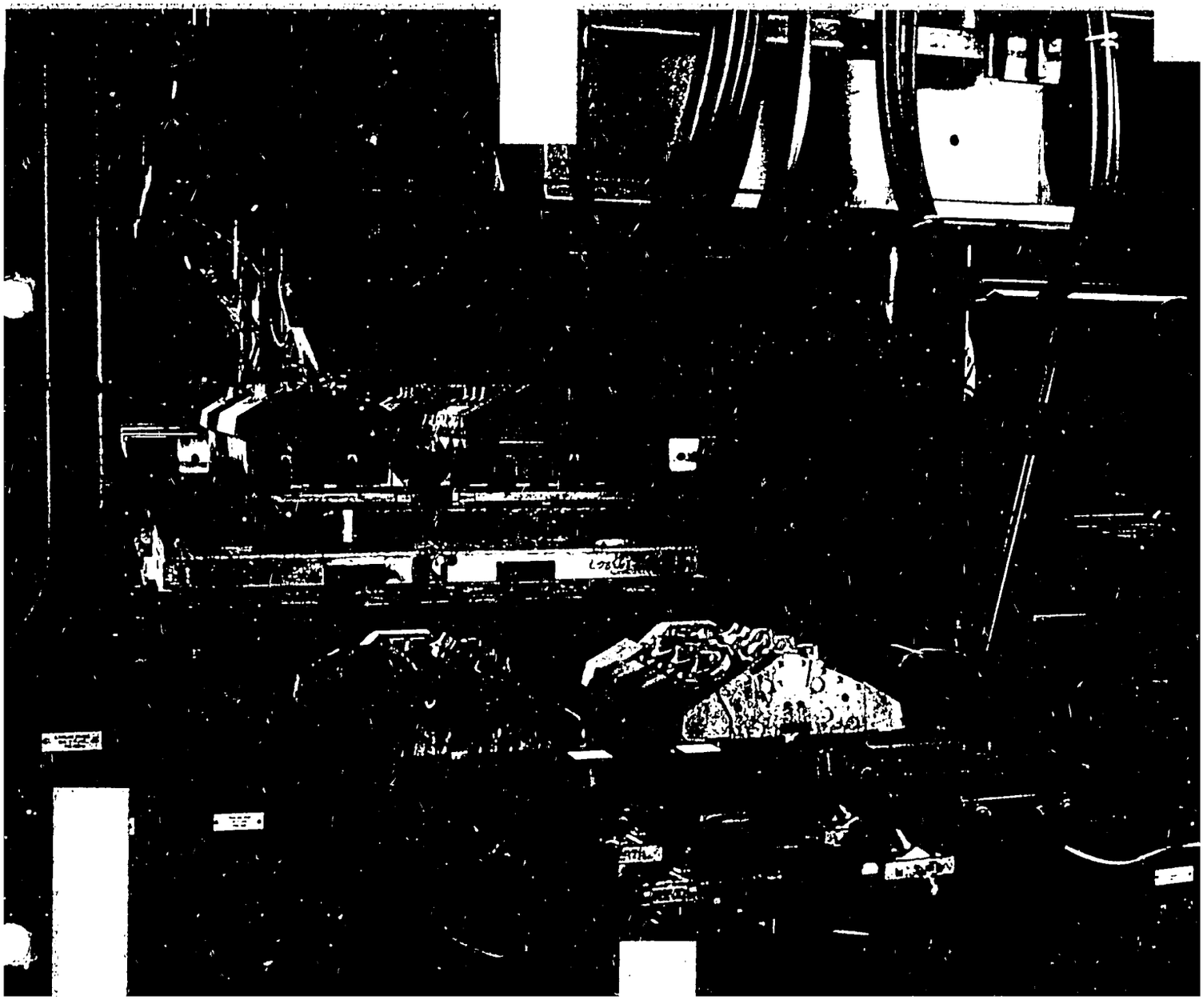
Korespondenční adresa:
GES, spol. s r. o.
P. O. BOX 294
729 94 OSTRAVA

49

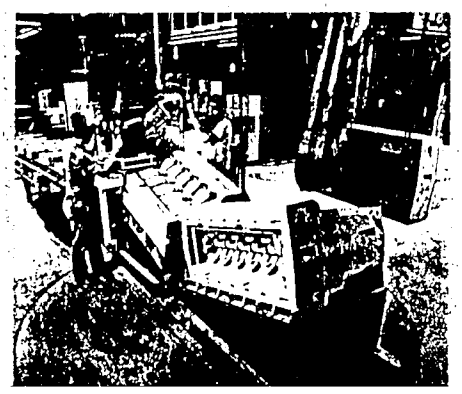
VI-2

VI-2

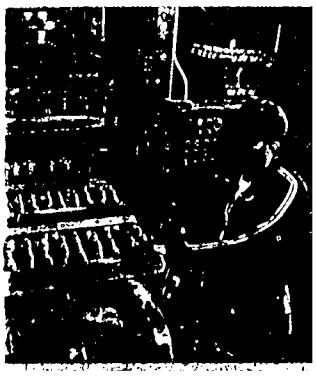
Ashland Chemicals



A



The Ashland Process—
for all sizes of foundries . . .
for all cast metals . . . for
cores and molds from ounces
to hundreds of pounds.



The patented Ashland Process, based on the ISOCURE® binder system, is the acknowledged leader among high-productivity core and mold production processes in the foundry industry. It has proved to be one of the most innovative and important developments in foundry technology in recent years.

Small jobbing shops and the largest automotive and farm implement foundries have discovered that the Ashland Process offers many advantages as a binder system for their core rooms and molding lines. Benefits include energy savings and economy, reduced scrap, higher productivity, improved finish, and outstanding flexibility, to name a few. In short, the Ashland Process is setting quality and productivity records in foundries around the world, and it can do the same in your foundry.

The Ashland Process is a cold box system for making cores and molds. The process employs a patented two component liquid resin binder system and a gas catalyst. Sand is mixed with the two liquid resin components, ISOCURE Binder Part I and Part II, typically at a 1.5 percent binder level based on the weight of the sand. This sand mix is then blown into a vented core box. A tertiary amine gas, one of the ISOCURE® 700 series catalysts, is blown through the core, contacts the binder on the sand, and produces an instantaneous cure to harden the core. Clean, dry air is then blown through the core to sweep out any residual amine gas, and the core can then be removed from the box. See the graphic representation of this process below.

If it sounds simple, it is even easier in actual production. And ease of operation is one of the many benefits your foundry can derive from the Ashland Process. Let's take a look at more of these benefits.

High Production

The Ashland Process is fast. Some foundries using the Ashland Process for small cores use cycle times of seconds. Large cores and molds are correspondingly fast in cycle times: for example, a 1,250 pound core for a locomotive engine assembly is routinely produced using a cycle time of 5 minutes, blow to blow.

This means that core rooms and molding lines can enjoy high core box or pattern turnover, usually reducing the amount of tooling needed. And core production can easily keep pace with high speed automated mold production lines.

Labor Savings

Higher productivity with the Ashland Process means that fewer operators can produce the same number of cores as a hot box or shell operation. And workers are easily trained to operate almost all currently available cold box machines.

No Heat Required

This advantage of the Ashland Process over hot box and shell systems provides many important benefits to the foundryman.

There are significant energy savings on critical fuel supplies, and of course the resultant cost savings on fuel bills.

There is an important improvement in worker environment. Eliminating processing heat improves worker comfort and creates a more conducive environment for higher productivity from each employee. Cores are ejected from the box at room temperature, and can be handled immediately. Tooling changes are quickly and easily accomplished on cold box machines. No critical production time is lost waiting for tooling to cool or to reach operating temperature.

Dimensionally Stable

The fast, complete cure of ISOCURE binders ensures that cores and molds are essentially cured when ejected from the box or pattern. Absence of heat from the process means that there is no thermal expansion or contraction to change dimensions.

Low Scrap

Because of excellent dimensional stability, and the fact that the core or mold is at nearly full strength when ejected, there is less breakage due to handling and less rejection. Mold scrap rates are dramatically reduced, and casting scrap is usually lower using Ashland Process cores and molds.

Low Cost

Total finished cost per core or mold, ready to use, is generally less than the same core or mold made in shell, hot box, or oil sand. Tooling costs are lower, because fewer sets of tooling are needed and tooling lasts longer with less maintenance.

Versatility

The Ashland Process is truly a versatile process. Core boxes and patterns can be wood, metal, or plastic. Ashland Process cores can be used with all cast metals, including iron, steel, aluminum, and copper alloys. The process is equally suitable for high production work, jobbing quantities, or bench work.

Less obvious, but no less important, is the experience Ashland has gained as a leader in manufacturing and marketing chemical binder systems. With each shipment of ISOCURE resin binders you receive the benefits of extensive quality assurance programs in our manufacturing facilities across the U.S.

Ashland maintains an active research and development facility, technical service personnel for field evaluation and customer assistance, and a staff of competent, knowledgeable sales personnel. In short, the Ashland Process offers not only well defined operating advantages, but the technical back-up and assistance to make the system work to your best advantage.

This portion of the brochure deals briefly with working with ISOCURE binders. It includes sand, mixing procedures, equipment, and some general tooling information. More detailed information on these areas is available in other Ashland foundry publications, available through your Ashland representative.

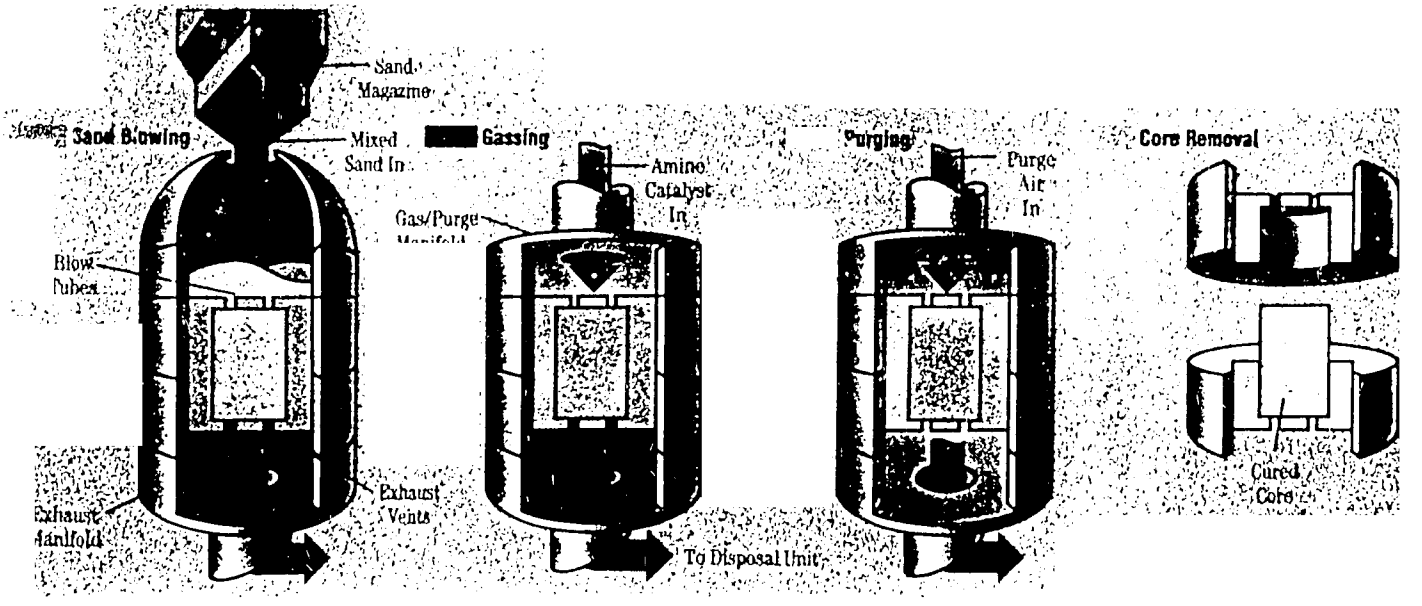
Sand

ISOCURE binders work well with most foundry sands; however bench life and tensile strengths may vary slightly with different sands. Sand with a low moisture content is desirable; core strength and bench life decrease as moisture content increases.

Sand Mixing

ISOCURE binders work well in a variety of mixing methods. Low viscosity of the binder ensures a highly flowable sand mix in either batch or continuous mixers. The two parts of the binder can be added separately or at the same time. Two-minute mixing is normally adquate in a standard batch mixer.

Sand can be easily prepared with ISOCURE binders in continuous mixers, either standard or high intensity, low retention type. When continuous mixers are used, the two resin components should be added to the sand stream separately. Sand can be fed directly from the mixer to the core box, or to the hoppers of core blowers for immediate use.



Bench Life

Bench life is the length of time after mixing that a batch of sand can be expected to produce acceptable cores. The bench life of an ISOCURE binder sand mix typically is one to two hours, and is affected by variables including type of sand, ambient temperature and sand temperature, type and amount of contaminants, amount of aeration, and acid demand value of the sand. The Ashland Process offers several different ISOCURE Part II components to compensate for these variables and extend bench life.

Forming The Core Or Mold

Cores can be formed by all of the conventional processes. Since the sand mix has good flowability, lower blowing pressures can be used. Typically a cold box core should be blown at 50 to 60 psi if it previously called for 80 to 100 psi in hot box or oil sand.

The blow air, and the air used for curing, must be dry. Wet air will cause lower core strength.

Cure

ISOCURE Catalyst 700 or 702 is mixed either with air, nitrogen or CO_2, and is passed through the sand mix in a vented core box. The ISOCURE binders are instantly polymerized and the core is hardened. There can be no over-cure, and no post-baking is necessary. Purging or flushing air sweeps the remaining vapors through the core and the cure is completed. As little as .05 to .07 percent catalyst, based on the weight of the sand, is sufficient with total binder level at 1.5 percent. To achieve low catalyst usage, it is important to have good flow-through of the air/catalyst mixture, which means properly sized and placed vents, and no leakage of catalyst at the parting line of the box, or at gassing manifold/core box contacts.

Machines

Ashland Chemical Company does not manufacture or market cold box equipment. A number of manufacturers curently offer cold box equipment which works well in the Ashland Process.

The basic cold box machine blows and gasses a core in a core box. It can, in a complete unit, mix the sand, blow and gas the core, eject the core onto a conveyor or pick off, and transport the finished core to the molding line, all automatically. A complete machine system can also include, as an integral part, its own gas generator; or the generator can be a separate unit designed to supply the catalyst vapor to one or several blowers. ISOCURE Catalyst 702 is also available in CO_2 in cylinders, eliminating the need for a generator; however this method is generally used only for small operations and has proven to be more expensive.

The range of sizes of machines available permits processing of a wide variety of cores and molds. In some machines core boxes move from the blow head to the gassing unit; in others the core box remains stationary and the blow head and gassing head move. Conversion units are available which adapt existing hot box or shell machines to the Ashland Process.

Tooling

Core boxes can be of wood, metal or plastic. Heavy and thin section cores can be made in the same box. Core box minimum metal section thickness is limited only by strength and not by heating requirements. Overall box size depends only on mechanical considerations. Core boxes currently are being designed with movable parts, cavity inserts, and disposable, low cost plastic liners.

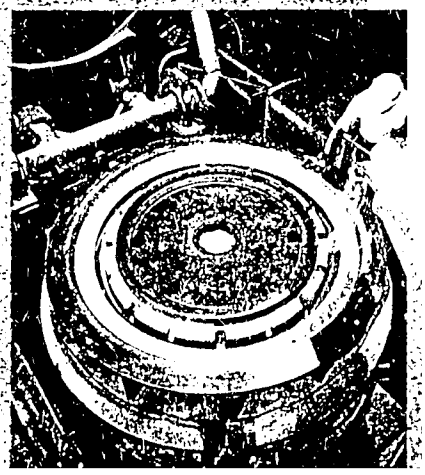
Ejector mechanisms can be designed into boxes for automatic release; because the box is cold there is no distortion or expansion of the ejection pins as is encountered in hot processes.

Other Aspects

Core pastes and coatings used with other core processes work well with Ashland Process cores. In many cases it has been found that coatings are no longer needed when Ashland Process cores are used.

Gas generation when pouring is less than that with phenolic and furan binders. The nature of these gases creates a desirable mold cavity atmosphere to improve the finish and appearance of the casting, accounting for the elimination of core coatings on some jobs.

Shakeout characteristics of Ashland Process cores are exceptional. Organic compounds in the binder completely break down in the presence of sufficient heat, leaving only dry, pourable sand. When used with non-ferrous metals, Ashland Process cores provide significantly faster shakeout than hot box or shell cores.



44102
2191 West 110th Street
216/961-4690

43216
Box 2219
614/889-3514

48071
32500 Concord Dr., Suite 352
313/585-2494

90040
6608 E. 26th Street
213/724-2440

L5J 4E7
Ashland Chemicals
2620 Royal Windsor Drive
416/823-1800

P.O. Box 2219
Columbus, OH 43216

Within Ohio: 800/282-7410
Outside Ohio: 800/848-7485

Ashland®

Ashland Chemical Company
DIVISION OF ASHLAND OIL, INC.

ISOCURE binders are packaged in 55 gallon steel drums and, for larger users, in bulk tank trucks. ISOCURE catalysts are packaged in 65 gallon steel drums.

For more detailed information on the Ashland Process and ISOCURE binders contact your local Ashland representative or one of the sales offices listed in this bulletin.

In the United States, Ashland has been awarded the following patents:

The Ashland Process: U.S. Patent Numbers 3,409,579 and 3,429,848

ISOCURE® Binder Systems: U.S. Patent Numbers 3,485,797, 3,676,392 and 3,432,457.

When Ashland Chemical Company materials are used, those materials carry with them a license for use under applicable Ashland patents. For materials from other suppliers, a license under appropriate Ashland patents must be obtained from Ashland Oil, Inc., Ashland, Kentucky.

Important: What is said in this booklet is offered for your consideration, investigation, and verification and is not to be taken as a warranty or representation of results. Nothing in this booklet is to be understood as permission or recommendation to practice a patented invention without a license.

All precautionary labels and notices should be fully read and understood by all supervisory personnel and employees before using. For additional safety and health information, contact Ashland Chemical Company. Purchaser has the responsibility for determining any applicability of and compliance with federal, state and local laws, and/or regulations involving use, particularly in making consumer products.

©Copyright 1987, Ashland Oil, Inc.
®Registered trademark of Ashland Oil, Inc.

Bulletin #1713
Printed in U.S.A.

VI-3

VI-3

Metalcasting Associations

Ohio Backs Reuse of Foundry Sand, Governor Tells Metalcasting Group

Ohio Gov. George V. Voinovich recently told the Ohio Cast Metals Assn. (OCMA) that the state's EPA has acted to remove the restrictive reporting requirements blocking the use of spent, nontoxic foundry sand in flowable fill.

The governor made his announcement to more than 100 OCMA members on October 14 at the organization's meeting in Columbus, Ohio. This was his first-ever presentation to OCMA.

Emphasizing the state's partnership with business, Voinovich said his administration will continue to work with OCMA to encourage the beneficial reuse of nontoxic foundry sand.

He said he was proud to say Ohio is the number-one metalcasting state and that he intended to help maintain that status. The state needs a strong manufacturing base to sustain continued economic growth, and that fact can be difficult to convey to others, Voinovich added.

The governor also reiterated his pledge to push for "real reform" in the state's workers' compensation program. Although it was difficult to implement recent reforms, he promised to hold the workers' compensation bureau's "feet to the fire" to ensure further improvements.

Voinovich asked for continued support from OCMA to accomplish this task.

Gov. George V. Voinovich (ctr) is flanked by Ohio Cast Metals Assn. President Charles T. Carroll (l) and Vice President Charles Rentschler at the organization's October meeting in Columbus. The governor said he will continue to work with OCMA to promote the reuse of spent, nontoxic foundry sand.

In other remarks, he called for a partnership between the state and business to create jobs, pledged to continue his efforts to make government "do more with less," and promised to further reduce burdens on business.

VI-4

SUMMARY OF FOUNDRY SAND REUSE OPTIONS IN OHIO AND WISCONSIN

Materials Prepared For
Ohio Cast Metals Association Meeting of April 6, 1994

RMT, Inc.
6457 Reflections Drive, Suite 110
Dublin, Ohio 43017-2352
Phone: (614) 793-0026
FAX: (614) 793-0151

57

SUMMARY OF KNOWN FOUNDRY SAND BENEFICIAL REUSE OPTIONS
PRE-APPROVED FOR USE IN OHIO AND WISCONSIN
MARCH 1994

Description	Wisconsin	Ohio
Daily cover at landfills (i.e., mandatory acceptance by landfill)	Yes	No
Foundation subgrade fill	Yes	No
Concrete/asphalt fine aggregate substitute	Yes	Yes
Paved roadway subbase fill (or highway base course)	Yes	Yes
Paved parking lot subbase fill	Yes	No
DOT contained embankment	Yes	No
Storage facility	Yes	No
Extraction and recovery of materials and compounds	Yes	Yes
Raw material for manufacturing a product	Yes	Yes
Mine subsidence stabilization, fire control, mine sealing	No	Yes
Blasting grit, roofing granules, other non-land applications	No	Yes
Flowable fill	No	Yes
Compost additive	No	Yes

NOTE:

Most options have some special testing, reporting, on-site characteristic requirements. These vary by state and option. "No" in table means pre-approval (either existing or pending) has not been granted, but case by case approval is possible.

Source: RMT, Inc.

Mark Your Calendar Now!

Plan on Attending the

FLOWABLE FILL DEMONSTRATION USING SPENT FOUNDRY SAND

Co-Sponsored by:

Thomas J. Neff, P.E., P.S., Cuyahoga County Engineer
Ohio Cast Metals Association
Institute of Advanced Manufacturing Sciences
Ford Motor Company
Kurtz Bros., Inc.
Collinwood Concrete

SAVE Money Now!	Substitute Foundry Sand in Your Product!
SAVE Money Later!	Flowable Fill Reduces Overall Project Costs!
SAVE Time!	Flowable Fill Reduces Overall Project Length!
SAVE The Environment!	Preserve Precious Landfill Space and Natural Resources!

May 12, 1994
2:00 p.m. - 4:00 p.m.

Cuyahoga County Fairgrounds
164 Eastland Road
Berea, Ohio

Program Schedule:

Registration	2:00 p.m. - 2:30 p.m.
Program/Speakers	2:30 p.m. - 3:30 p.m.
Live Demonstration	3:30 p.m. - 4:00 p.m.

Speakers Include Representatives From:

- Cuyahoga County Engineer's Office
- Hamilton County Engineer's Office
- Ford Motor Company
- Ohio Cast Metals Association
- Ohio Environmental Protection Agency

VI-5

VI-5

BENEFICIAL USE OF NON-TOXIC BOTTOM ASH, FLY ASH AND SPENT FOUNDRY SAND, AND OTHER EXEMPT WASTES

DRAFT COPY
SUBJECT TO REVISION
OHIO EPA

PURPOSE

This policy was developed to facilitate the beneficial use of non-toxic bottom ash, fly ash, and spent foundry sand, and other exempted wastes, and to assure that such uses do not cause water pollution

SCOPE

This policy sets forth beneficial uses of non-toxic bottom ash, fly ash, and spent foundry sand, and other exempted wastes. It describes notification requirements, design and operating standards, and siting criteria.

APPLICABILITY

This policy applies only to that non-toxic bottom ash, fly ash, non-toxic foundry sand, and other exempted wastes used or proposed to be used for a particular beneficial purpose in lieu of a competing raw material or finished product. This policy does not apply to residual or non-toxic waste disposal, or indiscriminate dumping/filling. This policy does not address construction or permit-to-install requirements for wastewater treatment as addressed in O.R.C. Chapter 6111, or permit to drill or permit to operate requirements of O.R.C. Chapter 6111 and Chapter 3745-34 of the O.A.C.

Non-toxic bottom ash, fly ash and spent foundry sand are exempt from regulation as hazardous or residual solid wastes and are subject to Ohio's air, land, and water pollution laws, this policy and Policy Number 0400.028 (for disposal). Residual wastes, as defined in O.A.C. Rule 3745-30-01, may be beneficially used in accordance with this policy.

Generators of waste should actively explore and implement all feasible alternatives to reduce the volume and toxicity of wastes, as well as on-site recycling, or recovery, before evaluating potential beneficial uses of the material.

Proposed uses of iron and steelmaking slag are not addressed by this policy. A separate policy covers this subject. Underground injection is not addressed by this policy and requires permits under O.R.C. Chapter 6111 and O.A.C. Chapter 3745-34.

Refer to Policy Number 0400.028 for design and construction of a disposal facility for non-toxic fly ash, bottom ash and spent foundry sand.

Post-it™ brand fax transmittal memo 7671	# of pages ▸ 12
To Bob Fechter	From Jenny Leshnock
Co. Ashland	Co. Ohio EPA DSW-N
Dept.	Phone # 644-2022
Fax # 889-4294	Fax # 644-2329

6

APPROVAL OF PLANS

Beneficial use of a waste covered by this policy shall not require a permit from the Agency, unless otherwise noted, if such use complies with the provisions of this policy. This policy does not provide any exemption from the requirements of O.R.C. 6111.043 and rules promulgated thereunder.

Proposals for land application (e.g. for nutrient benefits, soil conditioning, agronomic liming) require a plan approval from the Ohio EPA (except use in composting process and as a soil blending ingredient, as described by this policy). Low volume, experimental projects for land application may fall under a beneficial use Category 4 (see below).

DEFINITIONS

1. "Non-Toxic Bottom Ash, Fly Ash and Spent Foundry Sand" means bottom ash and fly ash generated by fuel burning operations which burn as fuel primarily coal, and spent foundry sand generated from foundry operations, where the leachate (from either an acid or deionized water extraction of the material, as determined in accordance with the testing procedures described in this policy) does not exceed thirty times the levels* specified in O.A.C. Rule 3745-81-11(B) for any parameter listed in the following table.

Parameter	3745-81-11(B) Ohio Drinking Water Standards mg/L	Non-toxic Criteria = 30x Standard mg/L
Arsenic	0.05	1.5
Barium	2.00	60.0
Cadmium	0.005	0.15
Chromium	0.1	3.0
Lead	0.05	1.5
Mercury	0.002	0.06

* For a waste to be considered non-toxic, the selenium concentration in the leachate may not exceed 1 mg/L.

In addition, spent foundry sand leachate shall not contain:

phenol exceeding 10.5 mg/L
cyanide exceeding 0.6 mg/L
fluoride exceeding 12.0 mg/L

2. "Beneficial Use" means the environmentally sound and technically feasible use of waste materials as products or raw materials in

61

lieu of a competing product or raw material in accordance with the conditions outlined in this policy or in accordance with conditions specified by the Ohio EPA. Beneficial use is not disposal and does not normally require a permit to use the material from the Ohio Environmental Protection Agency. Beneficial use status does not provide exemption from permit-to-install requirements for installation or operation of waste disposal systems. Beneficial use status does not provide exemption from permit to drill or permit to operate requirements for installation or operation of underground injection control wells. The term does not include valley fills, or the use of waste covered by this policy to fill open pits from coal or industrial mineral mining.

3. "Other Exempt Wastes" means wastes that are exempted from Solid Waste Regulation (O.A.C. Chapter 3745-27) or Residual Waste Regulation (O.A.C. Chapter 3745-30), not including non-toxic fly ash, bottom ash and spent foundry sand. Wastes can be exempted by definition (in the Solid Waste Rules), or by beneficial use in compliance with O.R.C. 6111.

4. "Category 1" means beneficial uses, indicated with an "x" in the table on Page 5 of 12, that do not require Ohio EPA review or notification. "General Requirements" apply.

   "Category 2" means beneficial uses, indicated with an "o" in the table on Page 5 of 12, where "Isolation Distances," "Other Criteria," and "Annual Report" apply. Examples: certain volumes of waste as structural fill; pipe bedding, roads/parking lots, and borrow pits when metals levels are not less than 5x Drinking Water Standards (DWS).

   "Category 3" means beneficial uses, indicated with an "xx" in the table on Page 5 of 12, of certain volumes of waste as structural fill, where "Isolation Distances," "Other Criteria," and a "30-day Prior Notification to Ohio EPA" apply.

   "Category 4" means beneficial uses not categorized or listed in this policy, where a 60-day prior notification of Ohio EPA is required. Ohio EPA consent is required to proceed.

MATERIAL TESTING REQUIREMENTS

1. Sampling Methods: A representative sample of waste shall be obtained by forming a composite of six (6) to twelve (12) discrete samples. The sampler should employ all reasonable measures, such as sampling at different times or conducting

random sampling of a representative pile, to ensure a representative composite is obtained.

2. Toxicity Testing and Analysis: Representative samples of waste should be characterized using the Toxicity Characteristic Leaching Procedure (TCLP, USEPA Method 1311). The TCLP acid extraction test or a modified TCLP extraction test (water solution specified in ASTM D 3987-85) may be used. The solutions may each be used for specific parameters as appropriate to utilize characterization knowledge from past testing. The solution chosen for a parameter in the initial test shall be used for that parameter in all subsequent tests of the material. For the purpose of obtaining an extract which will be analyzed for phenol, cyanide, fluoride, specific conductance, chlorides, sulfates, total dissolved solids, acidity, alkalinity, and pH, the water solution must be used.

3. Number of samples: Three initial test results for each parameter (listed below, Item 4) are required to show compliance with the non-toxic criteria, where applicable. If the beneficial use is in Category 4 (as described on pages 6, 10 and 11), the results shall be submitted to Ohio EPA Division of Surface Water with the beneficial use proposal.

   Alternatively, a statistical procedure, specified in SW-846 (USEPA's TEST METHODS FOR EVALUATING SOLID WASTES), may be used where a larger data base is available which is representative of the material (e.g. monthly analysis from the preceding 12 months), and where the testing and analysis criteria given in paragraphs 1 and 2, above, were used. The concentration of a parameter shall then be based on the upper limit of the 80% confidence interval for the test results.

   Proposed uses of other exempt wastes should use the same procedure, and results may be compared to the non-toxic criteria for ash and sand. Results of other exempt waste analyses may also be compared to the criteria for a "Class III Residual Waste" (O.A.C. Chapter 3745-30) when other constituents (above the seven metals) are present.

4. Parameters: The solution must be analyzed for the following parameters: acidity, alkalinity, aluminum, arsenic, barium, cadmium, chlorides, chromium, copper, fluoride, iron, lead, manganese, mercury, pH, selenium, specific conductance, sulfates, total dissolved solids, vanadium, and zinc. For proposed uses of other exempt wastes, an organic or dioxin analysis of the simulated leachate, or a chemical analysis of the material, may be required on a case-by-case basis.

5. Additional testing for continued beneficial uses: At a minimum, annual tests must be performed on the materials. In general, the annual analyses need not be submitted to Ohio EPA, but shall be kept for at least five years at the generating facility. The results shall be available to Ohio EPA upon request.

   Any result which exceeds the non-toxic criteria for bottom ash, fly ash, and spent foundry sand must be reported immediately to the Ohio EPA, Central Office, Division of Surface Water, Permits Section.

POLICY

Non-toxic bottom ash, fly ash, and spent foundry sand, and other exempted wastes may be beneficially used for the following applications without a wastewater or solid waste permit to install or permit to discharge. Notification of Ohio EPA is only required where specifically stated.

TYPE OF MATERIAL → / TYPE OF BENEFICIAL USE (See definitions)	RW	NON-TOXIC AND PHENOL 10.5 mg/L CN 0.6 * FL 12.0 *			20x DWS AND PHENOL 7.0 mg/L CN 0.4 * FL 8.0 *			10x DWS AND PHENOL 3.5 mg/L CN 0.2 * FL 4.0 *			5x DWS AND PHENOL 3.5 mg/L CN 0.2 * FL 4.0 *			DWS AND PHENOL 3.5 mg/L CN 0.2 * FL 4.0 *		
		FA	BA	FS	FA	BA	FS	FA	BA	FS	FA	BA	FS	FA	BA	FS
Manufacturing another product	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Stabilization/solidification of other waste (for disposal)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
In composting process	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Subject to procurement guidelines		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
With ODNR approval		X	X		X	X		X	X		X	X		X	X	
Anti-skid agent/road surface prep.			X	X		X	X		X	X		X	X		X	X
Soil blending ingredient			X	X		X	X		X	X		X	X		X	X
Daily cover @ landfill			X	X		X	X		X	X		X	X		X	X
Structural fill					XX (600-30,000 TONS) O (< 600 TONS)						XX (600 -30,000 TONS) O (200- <600 TONS)			XX (> 30,000 TONS) O (600-30,000 TONS) X (< 600 TONS)		
Pipe bedding					O	O	O	X	X	X	X	X	X	X	X	X
Roads/parking lots					O	O	O	X	X	X	X	X	X	X	X	X
Commercial uses (general)											X[1]	X[1]	X[1]	X[1]	X[1]	X[1]
Generator give-away														X[2]	X[2]	X[2]
Borrow pits					O	O	O	O	O	O	X[1]	X[1]	X[1]	X	X	X

FA = FLY ASH; BA = BOTTOM ASH; FS = SPENT FOUNDRY SAND; RW = RESIDUAL WASTE.

NOTE: PHENOL, CYANIDE AND FLUORIDE CRITERIA ONLY APPLY TO SPENT FOUNDRY SAND.

X CATEGORY 1 = NO OHIO EPA REVIEW OR NOTIFICATION.
O CATEGORY 2 = ANNUAL REPORT; ISOLATION DISTANCES, OTHER CRITERIA.
XX CATEGORY 3 = 30-DAY PRIOR NOTIFICATION TO OHIO EPA; ISOLATION DISTANCES, OTHER CRITERIA.

1 VOLUME LIMITATION (<200 TONS PER PROJECT); ISOLATION DISTANCES.
2 RECEIVER NOTIFICATION.

ALL BENEFICIAL USES SUBJECT TO THE GENERAL REQUIREMENTS LISTED ON PAGE 7. USES NOT CATEGORIZED OR LISTED ARE CATEGORY 4, i.e. 60-DAY PRIOR NOTIFICATION WITH OHIO EPA CONSENT.

BENEFICIAL USES

Manufacturing another product: The use as a raw material in manufacturing another final product, e.g., including, but not limited to, grout, flowable fill, lightweight aggregate, concrete block, bricks, asphalt, roofing materials, plastics, paint, glass, fiberglass, ceramics (except ceramic dishes or other kitchenware) and other non-land applications, or as a substitute for a product (e.g. blasting grit), excluding soil products.

Stabilization/solidification of other waste (for disposal): The use as a stabilization/solidification agent, singly or in combination with other additives or agents, for other wastes which will be disposed of.

In composting process: The use of a waste in a composting process when the process is performed in accordance with applicable composting regulations. This term does not include use of waste as a post-composting additive, or land application of waste.

Subject to procurement guidelines: The uses which are subject to procurement guidelines issued by the Environmental Protection Agency under Section 6002 of the Solid Waste Disposal Act (Public Law 89-272, 42 U.S.C. 6962).

With ODNR approval: Uses authorized and approved by the Ohio Department of Natural Resources (ODNR), i.e. use for mine subsidence control, mine fire control, mine sealing, and for neutralization in active surface mines. This term does not include land reclamation of mined lands, which would require a plan approval for land application from Ohio EPA Division of Surface Water.

Anti-skid agent/road surface preparation material: The use as an anti-skid material or road surface preparation material, if such use is consistent with Ohio Department of Transportation (ODOT) specifications or other applicable specifications.

Soil blending incredient: The use as an additive in commercial soil blending operations, where the product will be used for growth of trees or ornamentals, when the waste constitutes no more than 50% of the mixture, and, if the waste does not meet 5x Ohio's Primary Drinking Water Standards, the mixture may not be applied to grazed pastures, home vegetable/fruit gardens, or used for growing crops or fruit trees. This term includes use of waste as a post-composting additive.

Daily cover at landfill: Uses as daily cover at a solid or residual waste landfill if approved by DSIWM, meeting all technical requirements for daily cover. The amount of daily cover shall not exceed the amount required under an approved permit to install.

Structural fill: An engineered use of waste material as a building or equipment supportive base or foundation. The term does not include valley fills or filling of open pits from coal or industrial mineral mining.

Pipe bedding: The use as pipe bedding, for uses other than transport of potable water. Materials used in sanitary sewer projects shall comply with the specifications of Ohio EPA Policy DSW 0400.001, "Sewage: Collection, Treatment, and Disposal Where Sewers are Not Available."

Roads/parking lots: The use as a construction material (sub-base or final cover) for roads or parking lots, if approved by a Professional Engineer or the property owner, and ODOT (where applicable).

Commercial uses (general): Beneficial uses for commercial projects, in single project (location) volumes of less than 200 tons (except for generator give-away programs; see below). May include structural fill or foundation backfill if volume is less than 200 tons.

Generator give-away: A generator may give away or sell an ash or spent foundry sand, at the facility, in small volumes (e.g. to plant employees)

Borrow pits: Use of a waste to fill empty borrow pits that were created during road construction or other construction activities.

GENERAL REQUIREMENTS APPLICABLE TO ALL BENEFICIAL USE PROJECTS

1. The use shall not create a nuisance condition. The waste may not be used in a manner which is likely to cause an adverse impact to public health or the environment.

2. Storage piles at the site or facility where the material will be used shall not create a nuisance. Erosion control practices shall be used for the pile. Runoff should be eliminated or handled appropriately.

   Storage at the generating facility shall be provided in accordance with solid or residual waste regulations. Runoff at the generator must be handled pursuant to a general or individual NPDES permit.

3. Waste may not be placed in a stream bed, leach field or well.

ANNUAL REPORT

For Category 2, each applying facility shall submit an annual report to the Ohio EPA. The annual report shall be submitted by April 1 and shall include a summary of each beneficial use project completed during the previous calendar year. Each project summary shall include, at a minimum:

61

a. a description of the nature, purpose, and location of the project;
b. type of waste and estimated volume of wastes used; and
c. the leachate test results.

ISOLATION DISTANCES

Unless otherwise approved by the Ohio EPA, for Category 1 (only as noted) and all uses in Categories 2 and 3, waste may not be placed within:

1. 100 feet of any intermittent or perennial streams, unless the waste is otherwise protected by a properly engineered diversion or structure.
2. 300 feet of any drinking water well, including a well used for livestock watering;
3. the 100 year floodplain of any water of the state unless a properly engineered dike, levee or other structure that can protect the structural fill from a 100 year flood is permitted.
4. 5 feet above the aquifer system used as the primary source of water to wells within 2500 feet of the beneficial use site;
5. 100 feet of any wetland.

OTHER CRITERIA (APPLICABLE TO ALL USES IN CATEGORY 2 AND 3)

1. Surface runoff from the fill area is minimized during filling and construction activity. Erosion and sediment control measures are implemented in accordance with sound engineering practices. Run-on from adjacent areas must be diverted around the site.

2. Structural fill shall be covered with a minimum of 12 inches of compacted soil or an unspecified thickness of asphalt or concrete.

30-DAY NOTIFICATION (APPLICABLE TO ALL CATEGORY 3 USES)

At least 30 calendar days before initiating the proposed project, the person proposing such use shall submit a written notice to the Ohio EPA Division of Surface Water. Ohio EPA Division of Surface Water shall notify, in a timely manner, the applicant if there appear to be any problems with or deficiencies of the beneficial use request. Consent of the Ohio EPA Division of Surface Water is not required; however Ohio EPA Division of Surface Water may request more information or, if environmental problems seem likely, require that an alternative use be found.

The notice shall contain, at a minimum:

A description of the nature, purpose, and location of the project, including a topographic map showing limits of waste placement, the project area, including any wells, springs, streams, and wetlands within 1,000 feet, and any available soil maps of the project area.

The estimated beginning and ending dates for the project.

Construction plans for the structural fill, including a stability analysis when necessary, which shall be prepared by a registered professional engineer in accordance with sound engineering practice and which shall be signed and sealed by the engineer.

4. An estimate of the volume of a non-toxic bottom ash, fly ash, or spent foundry sand to be used for the project.

5. A leaching analysis for the material to be used in the project, in accordance with the testing procedures described in this policy.

If the waste is bottom ash and the TCLP test indicates that it meets Ohio's Primary Drinking Water Standards, then no notice is required. Project summaries shall be submitted annually as described in the previous section.

RECEIVER NOTIFICATION

For generator give/sell-away programs, each receiver shall be informed of the nature of the waste and that the waste may contaminate water if water is in prolonged contact with the waste.

DEVIATIONS

If the applicant can affirmatively demonstrate to the Ohio EPA Division of Surface Water that the non-toxic bottom ash, fly ash, or spent foundry sand or other exempt waste will not adversely impact the public health or the environment, the Ohio EPA Division of Surface Water may modify the design and location requirements set forth above.

CATEGORY 4: BENEFICIAL USES WITH OHIO EPA DIVISION OF SURFACE WATER REVIEW

Except for those uses which are defined in this policy, no person shall manage a non-toxic bottom ash, fly ash, or spent foundry sand, or other exempt waste for any beneficial use unless such person has first requested and received written approval from the Ohio EPA Division of Surface Water, or other appropriate divisions of the Agency.

A request for approval of beneficial use under this policy shall be on forms provided by the Ohio EPA Division of Surface Water (Attachment 1), shall be complete, received at least 60 days prior to the proposed use, and shall:

Chemically and physically characterize the material and identify the quantity, quality, and source of material to be used.

2. Describe the proposed method of application and demonstrate the beneficial use of the material.

3. Demonstrate that the intended use will not adversely affect public health or the environment.

4. If the Ohio EPA Division of Surface Water consents to a beneficial use request the Ohio EPA may:

   a. Limit the type, source, or amount of material to be used.
   b. Limit the term of the approval.
   c. Require the submission of an annual analysis or other appropriate information to ensure that the quality of the material to be beneficially used remains consistent with that stated in the approval.
   d. Include any other conditions the Ohio EPA Division of Surface Water believes appropriate.

5. The Ohio EPA Division of Surface Water, after considering the potential for water pollution, shall notify the applicant of the final determination on each beneficial use request in a timely manner.

6. The Ohio EPA may require discontinuation of a beneficial use if it is found that the beneficial use is being conducted in a manner inconsistent with the original request, or whenever the beneficial use is adversely affecting public health or the environment.

REQUESTS FOR INFORMATION

The Ohio EPA may at any reasonable time request all documents and other information necessary to demonstrate that an ongoing or proposed beneficial use of waste is being, or will be, conducted in a manner that is consistent with this policy.

Failure to have documentation of compliance with this policy available after initiation of a claimed beneficial use may be cause for Ohio EPA to require discontinuation of the use.

Attachment 1

Category 4 Beneficial Use: Proposal Information Sheet

General Information

1) Name of Project: _____
2) Entity Requesting Review: _____
3) Proposed Generator: _____
4) Type of Waste to be Beneficially Used: _____

☐ Fly Ash ☐ Foundry Sand

☐ Bottom Ash ☐ Other (define) _____

5) Proposed Use As: _____
6) Proposed Use Location (Enclose topographical map showing material placement boundaries, except for non-land application uses. Include lowest elevation of material placement): _____
7) Amount of each waste material to be used. (Include volume of waste and proportions when mixed with other non-waste materials. Also indicate acreage when land application is involved): _____

Data

1) Does the waste meet the criteria for being non-toxic (and spent, in the case of foundry sand)? Enclose TCLP toxicity test results.

☐ Yes ☐ No

2) Enclose boring logs for large volume land application uses, when available.
3) Do you have knowledge of other projects involving the same material and use?

☐ Yes ☐ No

If yes, please indicate the location and name of project(s): _____

4) Has a demonstration project been performed, associated with this particular proposed use?

☐ Yes ☐ No

If yes, please enclose any available results.

5) Has this generator's waste been beneficially used in other cases?

☐ Yes ☐ No

If yes, please indicate location and name of project(s): _____

Environmental Considerations

1) Is the proposed use location subject to flooding?

☐ Yes ☐ No

2) Distance from proposed location to nearest surface water: _____
3) Do you have knowledge of monitoring and/or potable water supply wells in the area?

☐ Yes ☐ No

If yes, indicate approximate location of such wells: _____

4) What are the adjacent land uses? _____
5) Are you aware of any potential (attributable to this project) or existing public water supply or ground water quality degradation in the area?

☐ Yes ☐ No

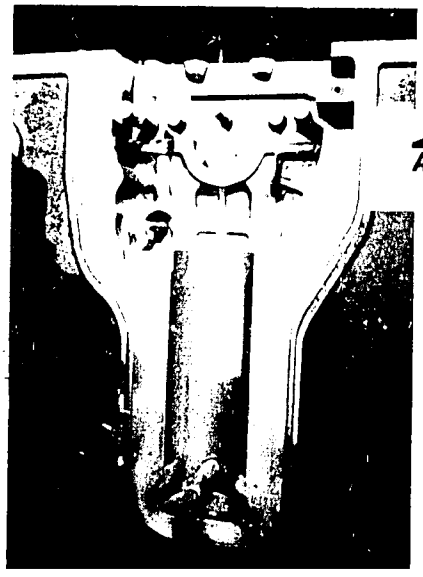
Explain: _____

Signature _____ Date _____

Company _____

Title _____

FOR THE ASHLAND COLD BOX PROCESS



Ashland Chemical

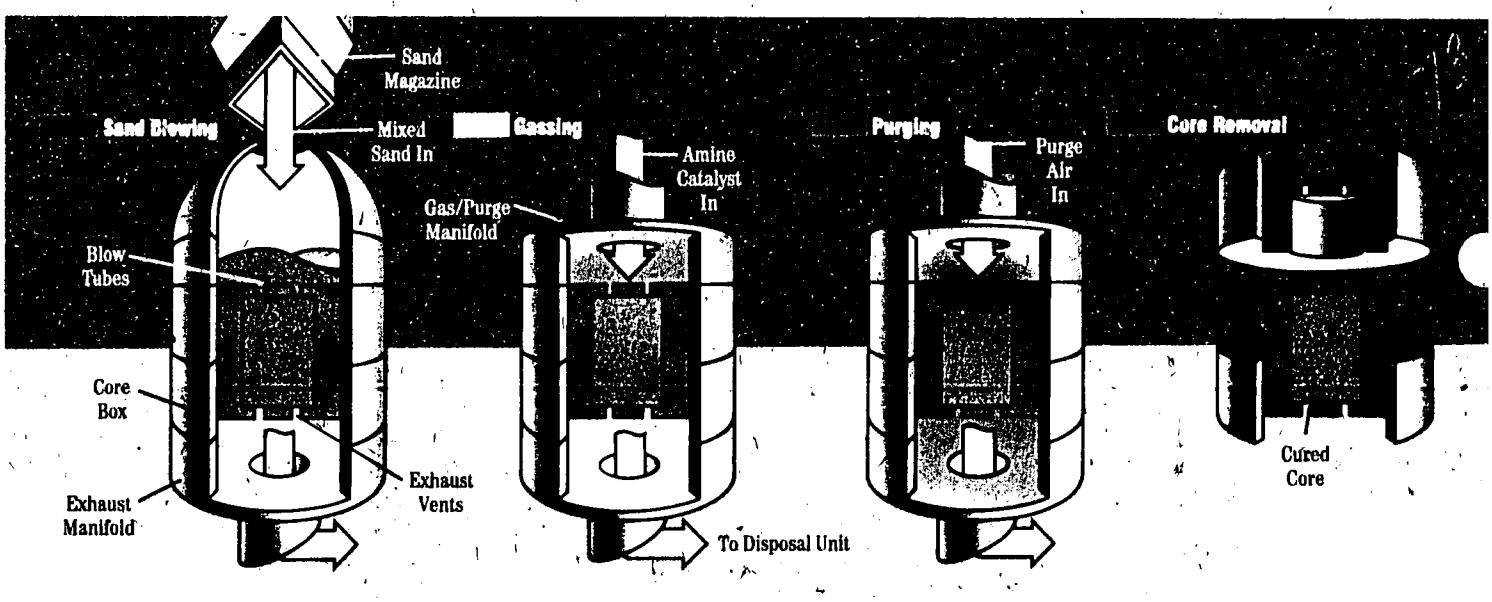


TABLE OF CONTENTS

1 INTRODUCTION
2 CONSTRUCTION MATERIALS
Input Piping & Manifolds
Core Box Seals
Exhaust Piping & Manifolds
Core Boxes
Blow Tubes
Vents
3 COMPONENT DESIGN CONSIDERATIONS
Sand Magazines
Input Piping & Manifolds
Core Box Seals
Exhaust Piping & Manifolds
[illegible]
[illegible] Core Boxes
[illegible]

The superior speed and economics achievable with the Ashland Process for cold box cores and molds can be directly related to effective and efficient tooling design. Proper core box design and rigging, including blow tubes and manifolds, sand magazines, vents, and exhaust ports, is essential for satisfactory results with ISOCURE® resin binders. The concept of blowing cores is not new. The Ashland Process uses the passage of a catalyst gas through the core for curing. The efficient flow of the gas into the core box and its exhaust require a common sense approach to the art of core box venting and rigging. Good design and planning in using the Ashland Process will provide a high productivity, low down-time, low maintenance cold box operation.

This bulletin has been produced to introduce you to the basic concepts in designing the tooling required for your operation. While it is generally accepted that venting is more an art than a science, the information contained in this bulletin represents a summary of past experiences based on successful cold box operations worldwide.

In some cases the information represents generalizations and "rules of thumb" which may or may not be applicable to your particular operation, and that decision rests with the individual foundryman. In using these guidelines in the design and installation of tooling, no specific predictions can be made as to eventual production rates, or downtime and maintenance requirements. Material selection, foundry conditions and practices, and personnel are all variables which may affect your operation, and should be taken into consideration.

The book cannot cover all the variations you may encounter; Ashland Chemical's technical personnel are available to help you solve those problems. For more information concerning the material in this bulletin contact your Ashland representative at the nearest location listed on the back cover.

CONSTRUCTION MATERIALS

The selection of materials for tooling plays a part in both the cost of construction and the subsequent productivity of the installation. The following information deals with materials commonly used for tooling for Ashland Process operations.

Input Piping and Manifold

Input lines, which carry the catalyst/air (or catalyst/inert gas/air) mixtures from the generator unit to the curing plenum (manifold), are characteristically a combination of rigid and flexible design. The rigid sections are commonly Schedule 40 black pipe. The flexible sections are best fabricated of amine resistant materials such as Teflon* TFE materials or Nylon Type II; however, with more frequent replacement, many varieties of hose normally used for compressed air and natural gas have proven satisfactory. Immersion of a small section of hose in liquid amine for a period of several days will reveal any swelling or softening of materials. The degree of swelling, or lack of it, will indicate the material's compatibility with amines and be an indication of usable life.

Whichever flexible tubing material is used, it must be capable of withstanding line pressure.

Gassing manifolds can be produced from mild steel weldments or fabrications, cast iron or cast aluminum. Construction from fabricated steel plate and cast iron are the most common. For prototype work for low production jobbing items, wood has also been used, preferably high-density pattern grade plywood. Strength design factors require these plenums to withstand gas and purge pressures without warping or flexing.

Core Box Seals

Compression seals are used between input manifolds and core box, and between the cope and drag halves of the core box. An immersion test should be made with the seal in all of the liquid materials used in the process: the Part I resin, Part II resin, amine catalyst, ZIP SLIP® release agents and #800 metal cleaner. If immersion testing in these liquids reveals excessive softening or swelling, a more resistant material should be selected (contact seal supplier for recommendations).

Seal compression strength is an important property for horizontally-parted core boxes. Seal compression strength should be low enough that it does not force the cope half of the core box upward as the clamping force is reduced after core blowing. If cope box movement occurs after blowing, sand sticking often occurs. This is particularly likely with light weight copes since they may not be sufficiently heavy to resist the resiliency of some core box seals. For this reason, many seal materials have a foamed structure, and compression specifications of two to five pounds per lineal inch are recommended. In some cases, even after low compression strength seals are selected, a separate cope-to-drag clamping mechanism should be employed to prevent box movement if the parting line cannot be maintained.

Exhaust Piping and Manifolds

Exhaust piping and manifold requirements are similar to inlet considerations with the exception that the pressures encountered are much lower (two to ten psi). Most exhaust plenums are steel weldments or cast iron frames with sealed access ports for cleaning. They must be structurally strong enough to resist the clamping force during blowing and curing, and provide solid support for the exhaust side of the core box.

Core Boxes

A great variety of materials are available for use in the core box itself. While cast iron construction is most commonly used, many experimental and some production boxes are fabricated from aluminum, wood, epoxy urethanes, and aluminum frame/plastic-lined structures. Solid aluminum or wood are seldom used in high production due to their low wear-resistance. The attraction of plastic and plastic-lined construction is lower initial and replacement cost.

One drawback to plastic tooling is its sensitivity to solvents used in some cleaning and release agents. For instance, urethanes are so solvent sensitive that blasting with walnut-shells or fine sand is preferred over solvent cleaning. When in doubt about solvent compatibility, consult with the plastic manufacturer.

Wear plates, positioned directly in line with blow tubes in the areas of sand impingement, must withstand solvent action as well. Hard ferrous metals are resistant as are Teflon TFE coated materials and Nylon Type II. Pre-use immersion testing of other materials is essential.

Blow Tubes

Blow tubes are most often made from medium carbon, thick-walled tubing or machined from cold-rolled steel bar-stock, depending on the design of the resilient tip seal to be used. A more recent development is the use of nylon and cast urethane blow tubes. The nylon tubes are generally quite resistant to the solvents used in ISOCURE (Cold Box) resins, but urethane tubes should be immersion tested in the Part I and Part II resins since many grades of urethane are available.

Tip seals are most commonly molded from urethane, Viton* rubber, or "blow tube rubber." If the latter commercial designation is used, pre-use immersion testing in the Part I and Part II resins is advisable to determine compatibility.

Vents

Brass vents of the woven-wire, perforated sheet, or slotted types are satisfactory; a combination of brass body with Monel** metal woven-wire head is preferable.

The more open area available for a given vent size, the greater the cure rate. High cure rates in the cold box process depend on the passage of a large volume of catalyst/air mixture through the core.

The woven-wire type vent, 25 to 30 mesh, provides the greatest open area for a given outside diameter (40 percent open), while perforated sheet and slotted types provide 27 percent and 13 percent open area respectively.

The woven-wire style in general is easier to clean than the slotted type with the 25 mesh commonly used for 50-60 GFN sand, and 35 mesh for 70-80 GFN sands.

Slotted brass vents with thick heads (i.e. 0.10") will be needed in areas of casting surface where contouring of the vent is required to preserve dimension. Such slot vents will prove more time-consuming to clean and will mean added expense because two to three times as many slotted vents are required to provide an equivalent catalyst/air passage area. Some slotted vents are available with reverse taper in the slot as a self-cleaning feature.

Perforated sheet vents have proven satisfactory. Nylon slotted vents, although providing some adhesion resistance to Isocure resins, are generally so low in open area as to be undesirable. They also exhibit a certain flexibility which allows wedging of sand grains into the slots.

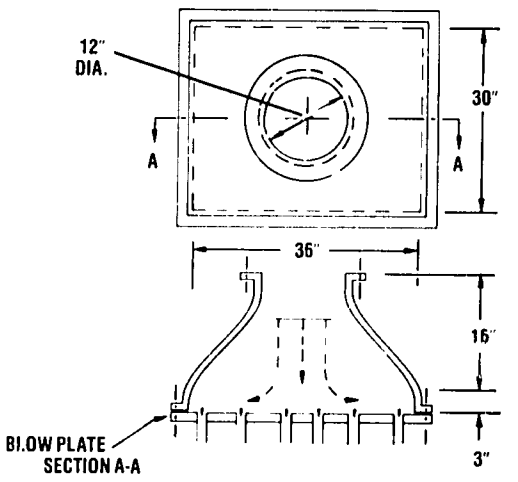
The so-called "self-cleaning" vents, either "flapper" or "christmas tree" types, generally do not provide enough open area to be effective and can easily be distorted during cleaning.

*Registered Trademark E.I. DuPont Nemours & Co.

**Registered Trademark International Nickel Company

Sand Magazines

The size and internal shape of a top-blow sand magazine, relative to the blow-plate it serves, will determine whether or not "dead" spots exist within it. These pockets of non-moving sand, in corners or between blow tube clusters, can age, harden and eventually form lumps which can clog blow tubes. At the least, the hardened sand which remains in the magazine after a day's run presents a time-consuming cleaning chore. At the worst, it causes down-time or scrap cores.



One design which promotes movement of all the sand during each blow is that of a cylinder fixed on top of a relatively shallow, rectangular box to which the blow plate is bolted. Figure I shows an example used with a large plate having many evenly-spaced blow tubes.

Conversion of a more conventionally shaped magazine to a special internal contour can be accomplished by insertion of metal, wood or plastic spacers, different for each blow plate if desired; these can be mounted into the magazine or onto the blow plate. Observation of the contour of hardened sand in a magazine following an extended run will indicate the desired shape of the spacers for a specific blow plate.

Whatever design concept is adopted, a useful parameter is that the total weight of sand in the magazine be limited to three to five times the blow weight. Greater weight ratios of magazine sand allow too much time for evaporation of solvent from the sand mix, resulting in reduced blowability. In an excessively large magazine, the sand may have air blown through it 10 to 15 times before it reaches the core box, thus reducing the effective bench life of the sand.

Input Piping and Manifolds

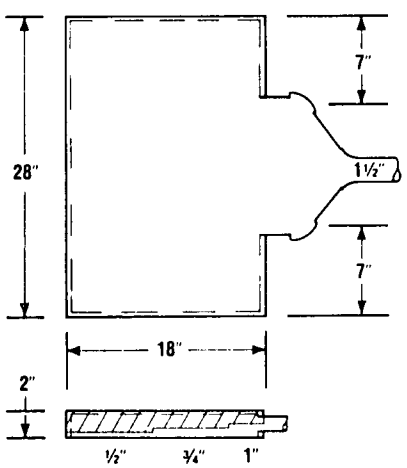
Design and sizing of the catalyst/air delivery system from the generator to the core box is critical to high cure rate and productivity. This system must be capable of delivering a large volume of catalyst/air mixture to the input side of the core at relatively low pressure during the first one to five seconds of the curing cycle. To accomplish this, the piping and manifolding from the point of catalyst injection to the core itself must be as unrestricted and follow as short a path as possible. This requires designing for a minimum of elbows and tees, with wye's preferred, and providing as short a length of travel as is practical from amine injection point to contact with the sand in the core box. Excessively long lines to the core box result in a curing delay at the beginning of each gassing cycle, as uncatalyzed air from the prior purge cycle is pushed through the system.

The minimum pipe and hose size from the amine generator or accumulator which will properly feed a plenum is dependent on the weight of sand to be cured after each blow. Information from actual production machines indicates the following:

Weight of sand to be cured	Minimum pipe diameter
1 to 15 lbs.	1"
15 to 50 lbs.	1¼"
50 to 100 lbs.	1½"
Over 100 lbs.	2" or larger

Care should be taken during installation not to inadvertently restrict the input piping. For instance, if an 1½" line from the generator is split into two lines for better distribution inside a large plenum a minimum nipple size of 1" should be used.

Figure
Input Piping and Cold Box



These pipe sizes, feeding a properly vented core box, can be expected to deliver sufficient catalyst/air mixture for a rapid cure by establishing a two to eight psi input plenum pressure during the first part of the curing cycle, and a 15 to 30 psi pressure during the following "cure and purge" part of the cycle. For the purpose of checking these pressures, a 0 to 30 psi gauge should be installed in the input plenum easily visible to the operator.

Experience has shown that a combined piping hose length of two to six feet between the catalyst injection point and input plenum provides the best operating characteristics.

The input plenum should be in direct contact with all the input vents in each core box cavity to ensure even distribution of catalyst over the input side of the core. A practical depth for a 12 in. x 12 in. plenum is ½ in.; for a 30 in. x 30 in. plenum it is 2 in. See Figure 2 for an illustration of input piping and plenum for a large core box.

Core Box Seals

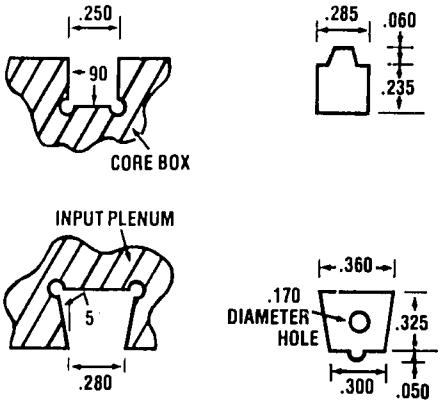
The preceding discussion has brought out the importance of maintaining certain gas flow and operating pressures during the curing part of the cold box process. It follows, then, that a pressure-tight seal must be accomplished between removable parts of the tooling, between input plenum and the input side of the core box, and between the two halves of the core box. Loss of this seal will reduce curing speed and will allow the escape of amine vapor into the operating area.

Minor leakage can be kept from the operator by the use of localized exhaust systems. However, the loss of pressure incurred with a major leak requires finding the source of the leak and correcting it. Major leaks cannot be compensated for simply by turning up the supply regulators.

In prototype installations, where curing speed is not essential and tooling is often wood or plastic in wood frames, sealing can be obtained by use of 1 in. to 2 in. core box parting surfaces and insertion of the entire core box into a closed "curing hood" equipped with sufficient exhaust capacity to furnish negative pressure inside the hood. On high production units, the sealing is accomplished by the use of flexible compression seals installed in the plenum and core box surfaces.

Many commercially available groove combinations have proven to be satisfactory. Most commonly, the plenum core box seal is located on the plenum itself, particularly when tooling calls for common gassing plates (plenums) to be shared by several core boxes. Core box parting line seals usually are located in the drag half of the box, when the box is horizontally parted. This facilitates replacement as needed and ease of inspection, and eliminates the need for adhesives in some cases.

Figure 3 shows two typical seal designs now in use. The dove-tail shape is more applicable to upper surface installation, while the square is better applied to a lower surface.



Exhaust Piping and Manifolds

The purpose of establishing size and general design parameters for the exhaust side of the sealed tooling is to ensure that it will allow maximum desired input air flow without exerting appreciable back pressure on the input system. A practical, attainable exhaust-side pressure is a maximum of one psi during the high pressure portion of the curing cycle. A practical exhaust side negative pressure, when suction-type amine disposal equipment is used, is minus one psi. Higher negative pressures will cause the catalyst to "channel" its way through the core, leaving uncured areas.

To ensure operation at this level and to indicate any gradual deviation, a − 10 to + 10 psi pressure gauge should be installed in the exhaust plenum in full view of the machine operator.

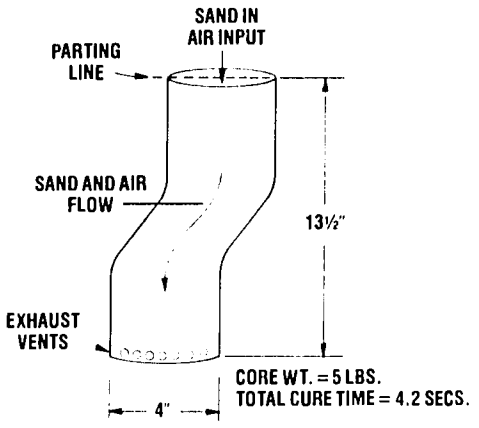
The most common practice in exhaust-side sealing is to build a plenum against which the drag or exhaust half of the core box is tightly bolted and sealed, and which is large enough to entirely enclose the stripping mechanism. This practice minimizes the required external sealing points and maintenance of stripper pins. Externally mounted, spring loaded seals for the stripper operating rods are commercially available.

Because catalyst/air volume must be maintained through the system, and because the exhaust side should operate near atmospheric pressure, the exhaust piping from plenum to amine disposal must have a minimum of **three** times the flow capacity of the input piping, and preferably four times or greater. For instance, if the unit uses 1½ in. diameter input piping, the exhaust from the plenum should be in the form of two 2 in. nipples, or one 3 in. nipple as a minimum. This open area must be maintained all the way to the disposal unit and through it, with no restrictions, using a minimum of elbows and tees.

Most exhaust piping designs have included a larger diameter section in the line to act as a sand trap. A two-foot long piece of 8″ diameter pipe, set into a 3″ line at right angles, will reduce velocity enough to trap sand which otherwise might be carried into the amine disposal unit.

The high production capabilities designed into the input and exhaust systems must be matched by a core box that can provide balanced and high-volume catalyst and air flow through the sand mix.

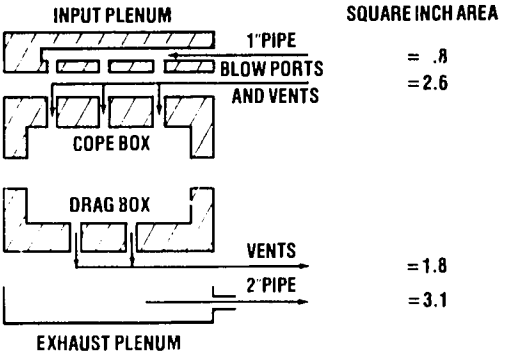
By far, the best way to accomplish this balanced catalyst flow is to locate the blow tubing and venting so that the flow of sand during blowing and the flow of catalyst/air during curing follow the same path and direction. A top blow, horizontally-parted box offers no real choice in this, since most machines on which it will fit can be adapted more easily to top-to-bottom catalyst/air flow; or, to bottom-to-top flow if an extremely heavy core weight suggests that positive curing adjacent to the drag stripper pins can be an advantage.



A top blown, vertically-parted box (i.e. an edge-blown box) offers a choice on most machines between top-to-bottom or side-to-side catalyst/vapor flow. Similarly, a side blown, horizontally-parted box offers the same choice. The high degree of venting necessary for rapid cure can interfere with dense blowing if the blowing is at right angles to the flow of catalyst/air. If blowing and curing are accomplished from the same side of the box, the venting aids in both operations, a fact worth remembering in the conversion of shell core boxes to cold box. Figure 4 shows an example of an edge-blown core which is edge-cured in this manner.

Horizontal-Split Core Boxes

The box first should be rigged with blow tubes, or ports, to blow with uniform core density and with as low of a sand entry velocity as possible. Proper tube diameter, total tube area and location of tubes will ensure a clean running box, and will also provide the uniform core density needed for ease of curing and resistance to metal penetration. Spongy core areas can inhibit catalyst/air diffusion into more dense areas and cause "sticking" to the core box at the spongy spots, particularly at air input vents.



*The delivery lines and input plenum area must be kept to a minimum. This provides the best conditions for an anaerobic cure.

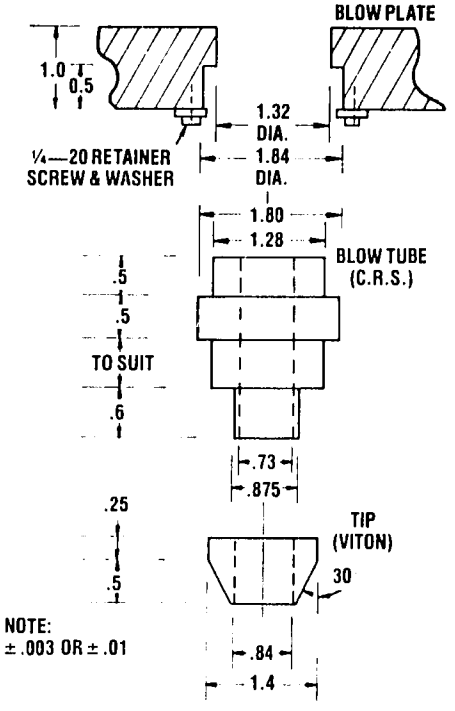
After blow tube location is decided, input and exhaust vent location can be determined. Blow tube ports and stripper pins are usually utilized as catalyst and air input and exhaust locations, with additional vents strategically located.

The total open venting area needed in each cavity for a high cure rate is generally two to four times the minimum required simply to blow the core. A rule-of-thumb is that the total vapor input area (blow ports plus cope vents) may be 130 percent of the blow tube area; exhaust vent area is less than the blow tube area and about 70 percent of the total vapor input area. Refer to Figure 5 for a graphic illustration of this.

Blow Tube Design

Two types of steel tubes are in use today. One is initially more expensive, physically rugged, and utilizes a press-fit resilient Viton rubber tip which acts as a compression seal during the blow. See Figure 6. The other is inexpensive, but thin-walled and easily damaged during handling and storage. See Figure 7. Opposing schools of thought emphasize the possible damage to the tooling from misalignment of the rugged tube, and the more frequent replacement of the more fragile tube.

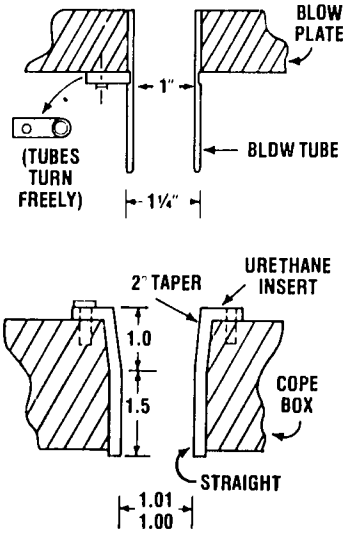
The greater popularity of the heavier, rugged tube seems to be due to two factors: a) dimensions (and even tubes themselves) can be standardized with the water-cooled tubes used in hot-box tooling when both processes are used in a large, high production shop, and b) the 30° beveled seal surface provides more positive sealing.

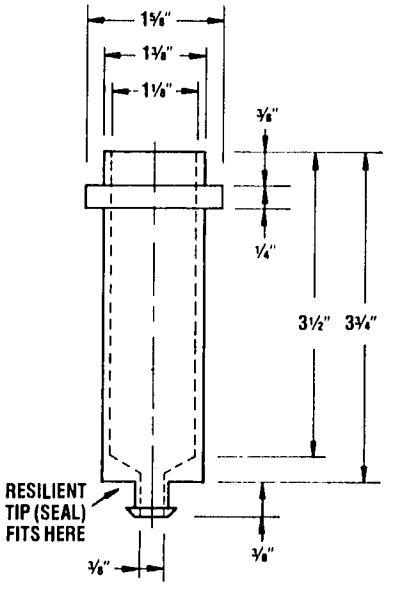


A third design type has been used with somewhat less overall success: a thin-walled tube incorporating a flexible (Viton or other rubber) extension which expands against the box to provide a sideways sealing action during the blow. These show a tendency to leak sand back onto the cover of the box during blow, especially when slightly damaged, and to wear out or ravel inside the flexible extension, partially blocking sand flow.

Inner surfaces of a tube ideally should be smooth and straight, with no restriction in the tube itself or at the junction of the tube with the resilient tip. Adhesion resistant coatings, such as Teflon coatings, are not needed; however, nickel plating, 0.002″ to 0.003″, may extend tube life.

Deviation from the principle of straight inner tube surfaces is required when blowing spindly cores which can only tolerate tubes of ½ in. diameter or less at the core contact point. Tubes are used which have a 1 in. diameter opening at the blow plate end, and which taper at about 45 degrees to the desired contact diameter just above the sealing point. This is particularly effective when dealing with tubes which must be more than 2 in. in length, because long, small tubes tend to close up from sand build-up after 10 to 15 blows. See Figure 8 for this design.





The more recently introduced nylon and urethane blow-tubes most often are straight, externally threaded tubing which screws into the blow-plate and is locked in place from underneath by a nut. Some cast urethane designs incorporate flanges for bolt attachment; others have tapered inside diameters to permit a single model to adapt to tip sizes from ⅜ in. to 1 in. inside diameter. All of these are used in conjunction with a tapered hole in the core box to effect a seal during blow.

Blow Tube Diameter

Inside diameters of blow tubes (or blow ports) should be as large as possible, up to 1¼ in. in some cases. The larger the diameter, the less the wear-promoting "rifling" effect during blowing, and the less tendency to plug with occasional hardened lumps of sand. Large diameters, when accompanied by sufficient total tube area per cavity, permit the use of low blow pressures, preferably in the 35 to 45 psi range. Low blow pressures result in cleaner running boxes by reducing the impingement velocity of the sand against the box surface, decreasing the amount of resin "wipe-off" at the impact point.

Of course, core or mold configuration will often limit the size of some of the tubes. In such cases, it is advisable to hold to a minimum of ⅝ in. inside diameter even if a less than ideal location must be selected. As explained under Blow Tube Design, a special shape of tube may be needed.

In the case of small, flat-back cores, blown vertically from the print side into a horizontally-parted core box, the tooling is mechanically simpler because a flat blow plate with chamfered or tapered holes can be substituted for a blow plate/tube arrangement. However, the advantages of the larger blow port diameter and total blow port area are equally valid, and contribute to clean-running boxes and dense cores.

Total Blow Tube Area

Production experience with ISOCURE binders has taught that minimum design guidelines can be established for the combined blow tube area required for a given box cavity, based on the weight of the sand. Such guidelines take into account the factors of good core density and the ability of the cavity to produce cores for more than eight hours without major cleanings.

Blow tube area varies from 0.20 square inches per pound of sand in the cavity to 0.35 square inches per pound, depending on core geometry. Chunky cores require the least area while rangy cores require a greater area. Examples of chunky cores are gear and transmission cases, engine blocks, end cores, pistons, pin cores, and barrel shapes. Rangy cores include automotive manifolds, transmission valve bodies, flat slabs, pipe fittings, and gas burners. The major differentiation is whether the sand moves straight away from the blow tube or must move generally sideways to fill the cavity.

Blow Tube Location

Proper tube location is much the same as with oil sand or hot box rigging, in that the most effective placement is one which will blow mainly into the heavier, chunkier core sections. This technique is more important with cold box because the very free-flowing sand tends to deposit free resin on the core box surface at the point where it changes direction in filling the cavity. The further away the direction change occurs from the end of the blow tube, the less will be the resin deposit directly under the tube.

It is poor technique to locate a tube close to, and directly in line with, a flat or sloping box surface, with the expectation of filling an adjacent heavy section. This increases the amount of sand which bounces off that box surface, promoting tooling wear, and leaving a resin residue. Even heavy application of release agent will not overcome such a design flaw because the release agent itself is sand blasted away.

Catalyst Vapor and Air Flow Considerations

Since higher catalyst and air mixture flow rates will provide faster cure rates in cold box operations, special design attention must be given to local input and exhaust area, vent diameters, and vent location. Insufficient open vent area, either input or exhaust, decreases cure rate. Inappropriate positioning also lowers cure rate and can result in excessive catalyst use due to "by-pass" of catalyst through thin core sections while thicker sections are not yet permeated with the vapor.

Cure rate is defined as pounds of sand cured (pounds per blow, all cavities) divided by the total number of seconds of catalyst and curing/purging air application (cure time) expressed in pounds per second.

Total Input and Exhaust Area

On the input side, considering only cure rate, it is impossible to install too much vent area. The limitation is the cost of drilling holes and the possible weakening of the box structure. On the other hand, too little venting can bring about low cure rate and "sticking" (lamination) to the cope vents.

On the exhaust side, the vent area should not exceed the total input area and is usually not more than 70 percent of that area.

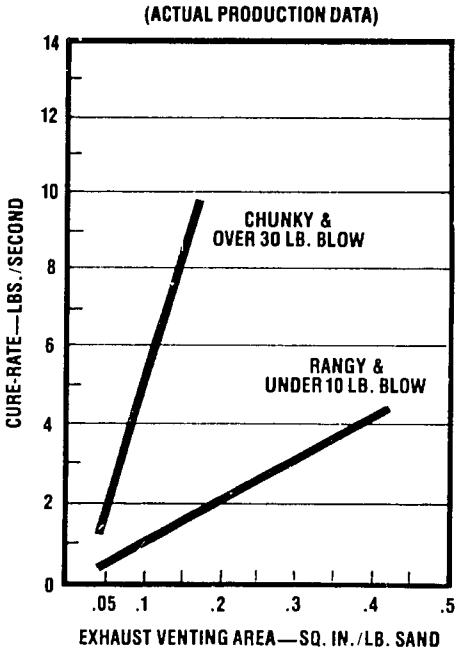


Illustration of the practical effect of greater venting area is seen in Figure 9, which is a plot of more than 20 production core boxes comparing their cure rate with their exhaust venting area. Vent area is expressed as square inches of open area per pound of sand in a cavity, because the weight of sand has a direct effect on the volume of catalyst and air required for cure.

As in the case of blow tube area, the configuration of the core has its effect on the optimum venting area. But it is easily seen that, whatever the configuration, increased vent areas yield dramatically higher cure rates.

By the use of coarse, relatively open, woven-wire type vents, and hollow, vented stripper pins, input areas of 0.25 square inch per pound are readily attainable in chunky cores, even in those with extensive lighteners on the cope (input) side. Similarly, areas of 0.40 square inch per pound can be built into rangy shapes. Figure 10 is a table useful in calculating open areas of input and exhaust. It lists the areas provided by various vents and blow tubes, as well as typical tube and pin clearances.

Assumed: Woven-wire vent effective open area per O.D. = 40% typical
Stamped sheet = 27%
Slotted metal = 13%

Blow Tubes & Pipes		Venting Area by Strip Pin Clearance		
I.D.	Area (in²)	Dia.	Clear (dia.)	Area (in²)
2″	3.14	1″	.020″	.032
1½″	1.77		.010″	.016
1¼″	1.23		.005″	.008
1″	.78	¾″	.020″	.024
⅞″	.60		.010″	.012
¾″	.44		.005″	.006
⅝″	.31	½″	.020″	.016
9/16″	.25		.010″	.008
½″	.20		.005″	.004
⅜″	.11	¼″	.020″	.008
5/16″	.08		.010″	.004
¼″	.05		.005″	.002

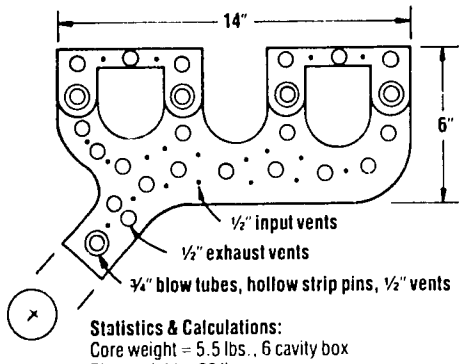
Woven Wire Vents		Slotted Vents	Venting Area Around Gassing Tubes, with 1/16″ Clearance On Dia.	
O.D.	Area (in²)	Area (in²)	Tube Dia.	Area (in²)
1″	.310	.100	1″	.100
¾″	.180	.060	¾″	.073
⅝″	.120	.040	⅝″	.060
½″	.080	.030	½″	.050
⅜″	.040	.015	⅜″	.036
5/16″	.030	.010	¼″	.025
¼″	.020	.006		

Vent Diameters

The proper diameter of vents is very often determined by the configuration and contour of the cavity; however, certain generalizations of common practice can be made.

In smaller core cavities, ten pounds or less, ½ in. diameter or smaller vents are common. In larger cavities, ⅝ in. or ¾ in. diameters can be used whenever configuration allows. In slab or tubular shapes, it may be convenient to standardize to a single size. In ribbed or uneven contours, many different diameters may be required, from ⅛ in. to ¾ in., because it is essential that all core projections have at least minimal venting no matter how thin the section. The important consideration is to install enough total input and exhaust area according to recommendations.

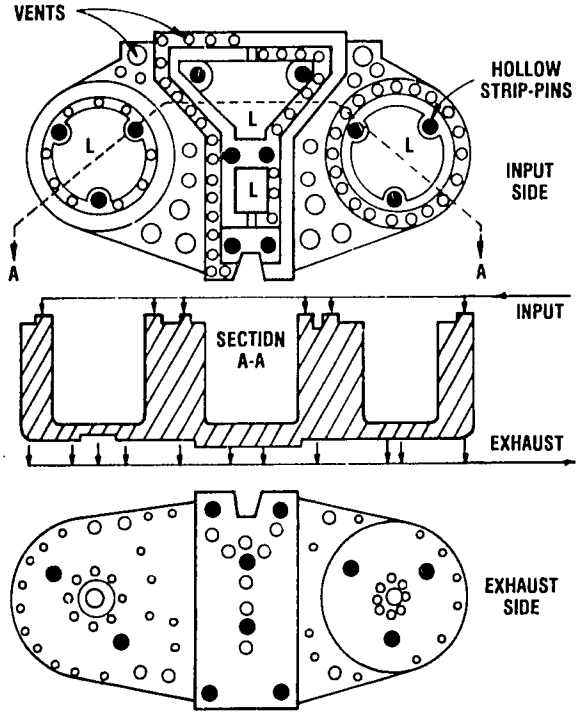
Figure 11
INPUT VENTS, TUBULAR CORE
(Typical Exhaust Manifold, cope side)



Statistics & Calculations:
Core weight = 5.5 lbs., 6 cavity box
Blow weight = 33 lbs.
Therefore; 5.5 lbs. × 36 in²/lb. = 2.0 in² input required/cavity
(Open area of ½" woven-wire vent = 0.8 in² each)

$$\frac{2.0\ \text{in}^2}{.08\ \text{in}^2} = 25 \text{ vents required}$$

Production results:
Cure-time = 10 seconds (total)
Cure-rate = 3.3 lbs./second
NOTE: 20 exhaust vents (½") in drag, staggered from cope (shown by dots) = 80% of input opening



Input Vent Location

A good technique in designing the venting is to position vents to flood the input side of the core with catalyst mixture. The exhaust side can be designed to lead the vapors to strategic exhaust points to ensure complete and proportional catalyst flow. An example of good input location on a simple slab is to space vents at no greater than 2 in. centers.

A logical first-choice position for input is at the blow tube locations and these should be utilized. If some of these locations are in core prints they may remain completely open during gassing. In casting areas a hollow combination gassing tube and stripper pin may be appropriate which will serve both to introduce catalyst and to flatten out any residual sand left by the blow tube. Pin diameter should be at least ⅛ in. smaller than the hole in the box, to allow air to flow around it. On a ¾ in. diameter pin, this area is greater than the open area of a vent placed in the stripper pin.

Once the blow tube locations are utilized, the additional venting required to bring total input area to the appropriate level is positioned according to contour, with particular attention to projections and high point on the core.

The catalyst mixture should have easy access to all areas of the input side of the core, either by connection with the input plenum, through a vent, or by path of flow from an input vent to an exhaust vent in the opposite side of the box. A useful rule-of-thumb is that the catalyst will spread out quickly along the input surface to a radius of about one inch from the point of entrance. This means that ½ in. diameter vents located on a flat input surface at two inch centers will adequately flood that surface. Greater spacing than the foregoing will not prevent the core from curing, but will extend the time needed for cure and increase catalyst consumption.

The even and symmetrical vent arrangement just described applies more strictly to a slab or tubular shape having rather uniform section and depth. See Figure 11, a manifold core which cures in less than 10 seconds. In dealing with cores which vary in depth of section, it will be advantageous to concentrate greater input area opposite the deeper sections, with the lighter sections carrying the remainder.

A transmission case core box, or an end core, with massive and deep lighteners in the cope half, requires a combination of these principles for proper location. Since the flat box surface on the blow (input) side is limited due to the lighteners, input vents must be concentrated there. If very heavy sand sections exist directly under the lighteners, input vents (or even

blow tubes) down through their centers may be required, but the technique of making the catalyst/air flow around the lighteners should be tried first. If successful, the need for long passages leading to such lightener vents would be eliminated; these passages can fill with sand escaping through the vents or around the blow tubes. See Figure 12, the box for a 37 pound core which cures in 10 seconds.

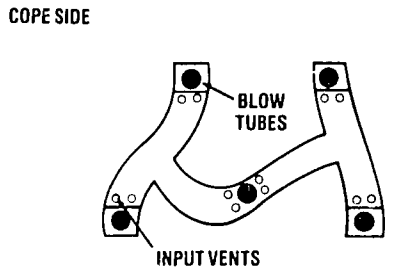
Exhaust Vent Location

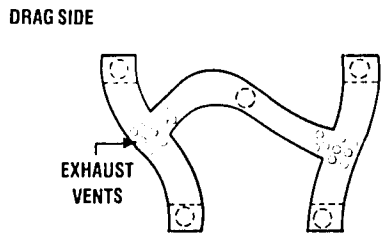
Once input vent position is decided, then exhaust venting can be arranged to "balance" the catalyst flow through the core. This requires an arrangement which creates roughly equal length gas paths from each input vent to the nearest exhaust vent, preventing catalyst "by-pass."

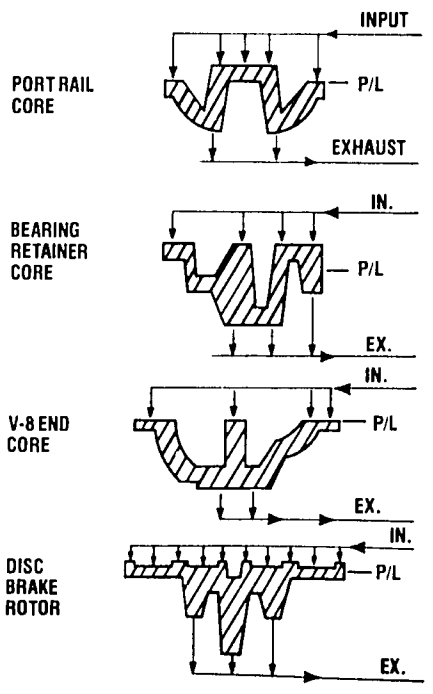
In the uniform core sections typical of slab or tubular cavities, this is accomplished by staggering the input and exhaust vents so they are not directly opposite each other. In uneven configurations, particularly those with lighteners or thin, lateral extensions from the body, this is more complicated. It involves envisioning the logical path of the gasses through the sand, bearing in mind that gas will always take the shortest path available from high pressure (input) to lower pressure (exhaust), then deliberately creating longer flow paths in the thinner core sections to correspond with the unavoidably long paths in the deeper sections.

See Figure 13 for typical intake manifold core venting. Note that all exhaust vents are in the lower box (core) areas, and that all input locations correspond with blow tube locations. This type of air-flow path results in both low catalyst consumption and good sand flow.

Figure 14 shows the cross section of several other production core shapes illustrating these principles. Solid arrows indicate good input and exhaust vent locations in horizontal-parted, top-blown tooling.







Vertical-Split Core Boxes

Proper design of this type of core box is increasingly important because of the heavy conversion rate from shell process into cold box. Many such conversions make use of existing tooling, and guidelines are helpful in determining required changes in blowporting and venting. Too often the foundryman will expect a shell box to function in the cold box process without changes. While this sometimes produces usable cores, it does not result in the high quality and high productivity achievable from cold box.

The general guidelines applicable to chunky, horizontal-split cores apply to most vertical-split jobs. Blow ports can usually be sized at 0.2 square inches per pound of sand. Exhaust vent area can be 0.1 to 0.2 square inches per pound. Simple shapes, without long projections or side-arms, can use the lower amount of openings. The considerations for input and exhaust piping also apply to these core boxes.

Some differences in rigging technique are required because of the orientation of most boxes selected for vertical-split treatment.

It is important that former shell boxes be blown in the best orientation for cold box, and not necessarily in the identical way which worked best for shell. Some boxes may be very difficult when edge-blown, but very simple if blown perpendicular to the parting line. An example would be an edge-blown shell box which had produced two cores, one above the other, but which is better in cold box when cross-blown from a horizontal-split orientation. The difference in sand blowability forces this in a few cases.

Blow Port Design

Since most vertical-split boxes are blown into a print area, the use of blow tubes is seldom required; blow-ports in a blow plate are the rule. Both round and slotted blow ports are common, slots preferable when an elongated print area is available.

A good idea is to chamfer the magazine side of the blow plate at 45 degrees, about half-way through the plate. This minimizes squirting of the sand and improves flow through the port. It is just as important here to have smooth, low velocity sand entry to minimize resin wipe-off, as it is with horizontal-split tooling.

Blow Port Size

While the "bigger-the-better" sizing of blow ports holds true in this type of tooling, there is a practical limit because of sand waste and the problem of spill sand cluttering up the machine area. With most sand mixtures of 1.5 percent to 2.0 percent resin content, a slot of ⅞ in. width, or a round port of 1 in. diameter, is ideal. With mixes of 1.0 percent resin, a port of ½ in. width or ¾ in. diameter leaves less of a windrow or mound. The length of the slot, or the number of large blow ports, is selected to give the proper amount of blow port area for the particular core.

In the case of very elongated cores, large blow ports can be critical to blowing a dense core, or even to filling the box at all. In pincores and "J" shapes, large blow ports and longer blow times (2 to 3 seconds) will give better compaction by reducing sand velocity and turbulence. Particularly in the port core and "J" shaped cores, wherein sand must move sideways or reverse its direction, the concept of large blow ports can spell the difference between success and failure in core quality and productivity. It is extremely important in these type cores that the sand flow and the catalyst/air flow follow the same path; i.e., edge-blow and edge-cure.

Catalyst/Air Input Area

With most vertically oriented cores the print area is sufficient for air input. There cannot be too much area as far as input is concerned. Input vents are not usually required, except in boxes in which the core bulges below the blow port location more than 2 in. outside the print. In such cases, vents on 2 in. centers will speed cure. The catalyst/air input plenum can be a simple, five-sided box which lowers the entire area of the core print, as well as the area of the input vents if used.

Exhaust Vent Location

Most of the exhaust vents in these boxes should be at the farthest point away from the input location. In the case of pincores, they are all located in the bottom print area. In the case of more complex cores, most vents are at the bottom, but small vents must be placed at the extremities of any long projections of more than 1 in. in length. They should be no larger than required to blow the projection tightly, because they will leak curing air and make it more difficult to cure the deeper parts of the core. See Figure 15 for tubing and venting of a barrel-shape and a "J" shaped core as actually accomplished in a high production situation.

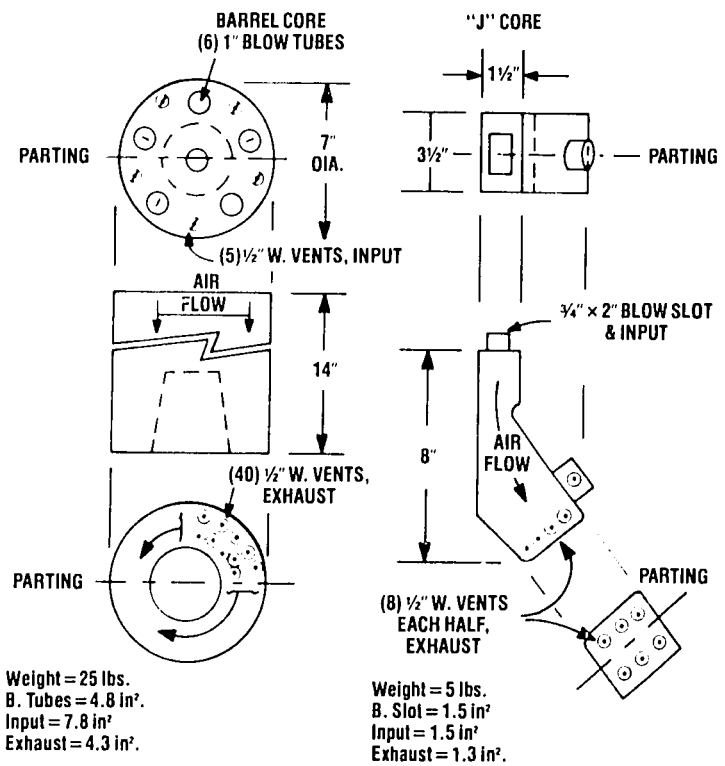


Figure 15
TUBING + VENTING, BARREL & "J" CORE

With the application of the foregoing guidelines and a certain amount of ingenuity with unusual and irregular shapes, the Ashland Process can be run with a minimum of amine catalyst and a maximum cure rate. In reaching this situation it must be recognized that a properly adjusted amine vapor generator, of optimum size for the job, is essential. Please refer to "Amine Vapor Generators for the Ashland Cold Box Process" for more detailed information.

Attainable levels of TEA usage range from 0.3 ccs/lb. of sand on heavy, deep cores to 0.5 ccs/lb. of sand on light, thin slab-like cores. These figures translate into 0.95 lbs./ton of sand and 1.6 lb. /ton; or 0.04 percent and 0.07 percent based on sand weight. Attainable levels with the use of DMEA may be as much as 30 percent lower than with TEA, but this is not certain because the practical, attainable levels cited here include loss due to leaks and unavoidable inefficiencies in venting.

The reason we experience different practical levels for deep cores than for thin, slab-like cores is that catalyst distribution is never perfect. The minimum TEA level required to cure is less than 0.02 percent b.o.s. if perfectly utilized, and levels as low as 0.015 percent of DMEA have been reported on a well-sealed, small, cylindrical core box run in production under close supervision. Perfect utilization, of course, requires no by-pass venting, leaks or non-uniform flow through the sand. It is an unattainable ideal in practice.

Attainable cure rates, defined in pounds/second-of-cure, have been noted by observation of well-rigged core boxes in production. Cure rates lower than eight pounds per second on heavy, deep cores indicate inefficient core box rigging or improper generator adjustment. In fact, very large cores in the range of 200 to 300 pounds are being processed at cure rates as high as 13 pounds per second with the use of TEA/air injection generators.

Cure rates lower than three pounds per second, on thin, light cores having a blow weight under 20 pounds, also indicate inefficiencies in rigging or generator adjustment. Please refer to Figure 9 for a survey of some of the cores and molds now in production.

ISOCURE BINDER WORKSHEET

Company: _____

Date: _____

Core Box Number _____

Type Parting (V or H) _____

Core Weight (lbs.) _____

No. Cavities _____

Core Machine: No. & Brand _____

Amine Generator: Type & Brand _____

Amine (TEA or DMEA) _____

Carrier (Air, Nitrogen, CO_2) _____

Accumulator: size ($ft.^3$) _____

Sand Mixer: Type, Brand, Size _____

Note Problems & Recommendations

_____

Variables:	Target or Optimum	Existing or Standard	Changed To
Materials: Sand, Type, No. or GFN			
Resins: Nos., Ratio, % bos			
Additives: Name, % bos(r)			
Release: Name, No.			
Tooling: Input Hose (diameter & length)	1" x 10' under 20#		
Box Input (in^2/# sand)	.25 Chunky .35 Rangy		
Box Exhaust (in^2/# sand)	.15 Chunky .25 Rangy		
Exhaust Hose (dia. & lgth.)	2" x 20' under 20#		
Blow tubes (ports) (in^2/# sand)	.20 Chunky .40 Rangy		
Operation: Blow (secs. @ psi)	35-45 psi		
Gas/LP Air (secs. @ box) @ psi	2-5 psi (H) 5-9 psi (V)		
Purge/HP Air (secs. @ box) @ psi	15-30 psi		
Exhaust Pressure (psi)	+ or − (1)		
Amine Pump (cc's or turns)	.3-.5 cc's/# sand		
Summary: Total Cure Time (secs.)	5-10*		
Blow-Blow Time (secs.)	20-50*		

*Up to 100# of sand.

Blow Tubes & Pipes I.D.	Area (in^2)	Venting Area by Strip Pin Clearance Dia.	Clear (dia.)	Area (in^2)
2"	3.14	1"	.020"	.032
1½"	1.77		.010"	.015
1¼"	1.23		.005"	.008
1"	.78	¾	.020"	.024
⅞"	.60		.010"	.012
¾"	.44		.005"	.006
⅝"	.31	½"	.020"	.016
9/16"	.25		.010"	.008
½"	.20		.005"	.004
⅜"	.11	¼"	.020"	.008
5/16"	.08		.010"	.004
¼"	.05		.005"	.002

Woven Wire Vents* O.D.	Area (in^2)	Slotted Vents Area (in^2)	Venting Area Around Gassing Tubes, with 1/16" Clearance On Dia. Tube Dia.	Area (in^2)
1"	.310	.100	1"	.100
¾"	.180	.060	¾"	.073
⅝"	.120	.040	⅝"	.060
½"	.080	.030	½"	.050
⅜"	.040	.015	⅜"	.036
5/16"	.030	.010	¼"	.025
¼"	.020	.006		

*use only steel vents

For more copies of this form use this page for reproduction or request additional copies from your Ashland Chemical representative.

PUT THE ASHLAND TEAM TO WORK FOR YOU

Ashland Chemical's Foundry Products Division consists of a *team* that makes total customer services its highest priority.

Serving our customers means investing in the future. Ashland has opened a state-of-the-art resin plant and modernized the tank farm and other areas of one of our Cleveland plants. We have upgraded private industry's only metals application laboratory to improve work flow, testing accuracy and employee safety.

Serving our customers means developing new products. The Foundry Products Division's aggressive new product program is helping customers meet the need for greater productivity, lower costs, and environmental compliance.

Serving our customers means providing value-added services to help them understand and comply with increasingly stringent environmental regulations. Ashland Chemical offers customers our SAFE FOUNDRY℠ manual and regular updates, a drum recycling program, and the introduction of numerous environmentally acceptable products.

As a member of the Chemical Manufacturers Association, Ashland Chemical is taking the initiative in implementing programs regarding product stewardship, waste minimization, plant safety, community relations, and emergency response. We are eager to help our customers meet regulations in these areas as well.

The next time you need foundry chemicals or any of our value-added services, call on the Ashland team.

We're working to become a member of *your* team too.

TYPICAL PROPERTIES - WARM BOX PRODUCTS

VI-7

CLASS 057 WARM BOX BINDERS

Code	Name	Viscosity cPs	% Water	% N_2	% FA (Total)	% Formaldehyde	Lbs./Gal.	Flash Point °F
057-900	CR Warm Box FB 900	200	8	- 0 -	57	0.05	9.9	170
057-989	CR Warm Box FB 905	100	1	2.5	67	0.3	9.7	170
057-925	CR Warm Box FB 925	100	3	0.8	62	0.4	9.9	170
057-920	CR Warm Box FB 950	200	8 max.	4.5	57	1.5	10.0	170
057-985	CR Warm Box FB 963	400	8	4.5	57	1.2	10.1	170

WARM BOX CATALYSTS

Code	Name	Copper Wt %	Free Acid MEQ/g	% H_2O	Lbs./Gal.	Flash Point °F
057-941	CR Warm Box Catalyst FC 138i	5.6	0.4	15	9.2	54
* 057-921	CR Warm Box Catalyst FC 150	9.5	0.3	6.5	9.4	54
* 057-922	CR Warm Box Catalyst FC 163	10.0	0.1	4.7	9.2	64
057-923	CR Warm Box Catalyst FC 165	9.5	0.1	5.0	9.3	54
057-986	CR Warm Box Catalyst FC 180	9.5	0.45	6.5	9.5	54

WARM BOX RELEASE AGENTS

Code	Name	Viscosity cPs	Lbs./Gal.	Flash Point °F
* 057-924	CR Warm Box Release NFA	30	9.3	150

* Recommended

VI-8. CURRICULUM VITAE OF GARY WANDTKE

PROFESSIONAL BACKGROUND OF WEC VOLUNTEER SPECIALIST

GARY GEORGE WANDTKE

POSITION Certified Plant Engineer

EXPERTISE Metal casting work and related foundry operations work, with preference in methods and Engineering.

EDUCATION 1966 BS. Industrial Mangement, minor in Geology.
Purdue University, Indiana

EXPERIENCE SUMMARY

12/80 - Present
Technical Sales Representative, Ashland Chemical Co., Ohio.
Exclusively service foundries in Northeastern U.S.

10/75 - 12/80
Plant Engineer, Victaulic Company of America, Pennsylvania
Plant Engineer in charge of capital projects, new expansion and environmental management.

4/75 - 10/75
Self employed for contract engineering and drafting service.

4/73 - 4/75
Electric Foundry Superintendent, ITT Grinnell Corporation, Pennsylania
Supervised 148 employees and ten foremen. Was responsible for overseeing core production in two departments which supplied cores to four Foundry Areas, as well as scheduling three automatic molding lines and core machines.

6/70 - 4/73
Mechanical Engineer, Hayes-Albion Corporation, Michigan.
Developed nodular iron production capability which included designation of process requirements and equipment required to produce Nodular Iron.

6/66 - 6/70
Process Engineer, General Motors Corporation, Michigan
Worked with captive foundry producing grey iron automotive castings. Developed and installed major updating processes in the Hot Box Cylinder Block Core Department.

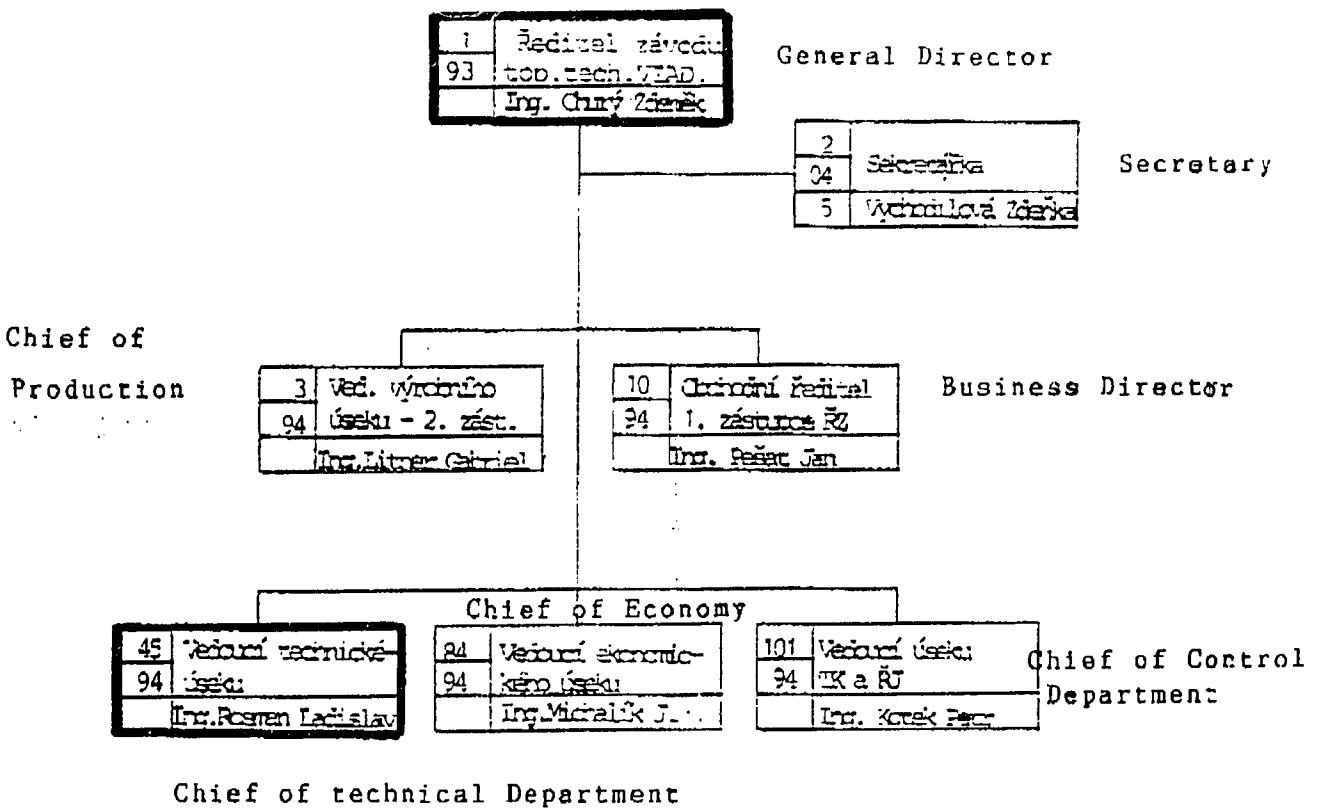
gv

VII. ORGANIZATIONAL CHARTS OF VIADRUS CO.

Registrační číslo	090
Strana:	1

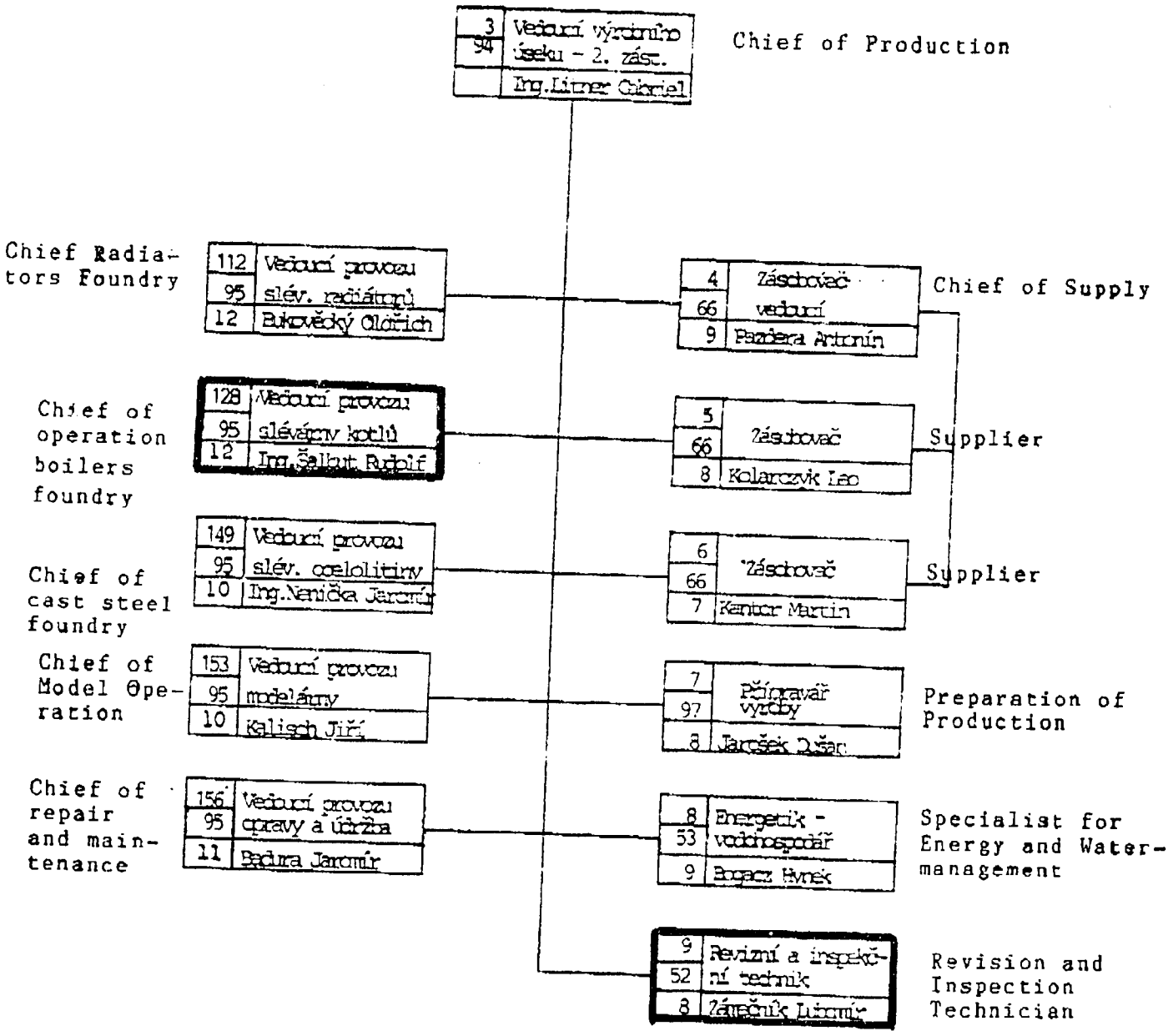
Organizační schema THP závodu topenářské techniky VIADRUS

DIAGRAM OF ORGANIZATION IN VIADRUS PLANT



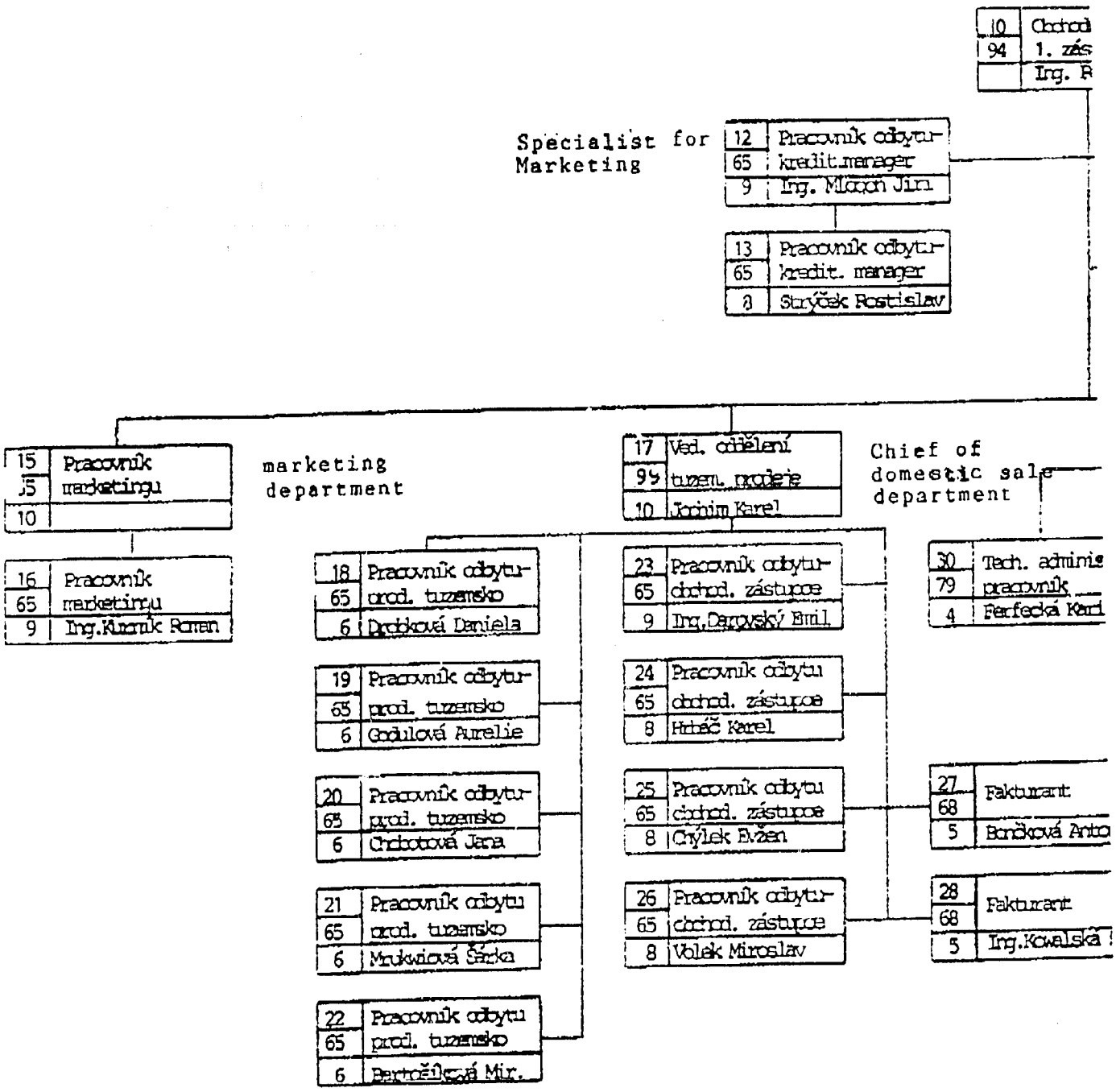
Stav:	2
Účinnost:	1.1.1995

Registrační číslo:	090
Strana:	2



Stav:	7
Účinnost:	1.1.1995

VII-2


10 Chchod
94 1. zás
Ing. R
Specialist for Marketing
12 Pracovník odbytu-
65 kredit.manager
9 Ing. Mlčoch Jiří
13 Pracovník odbytu-
65 kredit. manager
8 Stryček Postislav
15 Pracovník
65 marketingu
10
marketing department
16 Pracovník
65 marketingu
9 Ing.Kuzník Roman
17 Ved. oddělení
95 tuzem. prodeje
10 Jochim Karel
Chief of domestic sale department
18 Pracovník odbytu-
65 prod. tuzemsko
6 Drdíková Daniela
19 Pracovník odbytu-
65 prod. tuzemsko
6 Godulová Aurelie
20 Pracovník odbytu-
65 prod. tuzemsko
6 Chobotová Jana
21 Pracovník odbytu
65 prod. tuzemsko
6 Mrukwicová Šárka
22 Pracovník odbytu
65 prod. tuzemsko
6 Bartošíková Mir.
23 Pracovník odbytu-
65 chchod. zástupce
9 Ing.Darovský Emil
24 Pracovník odbytu
65 chchod. zástupce
8 Hráč Karel
25 Pracovník odbytu
65 chchod. zástupce
8 Chýlek Evžen
26 Pracovník odbytu-
65 chchod. zástupce
8 Volek Miroslav
30 Tech. adminis
79 pracovník
4 Ferfecká Kard
27 Fakturant
68
5 Boníková Anto
28 Fakturant
68
5 Ing.Kowalská

VII-3

Registrační číslo	030
Strana:	3

Obchodní ředitel
1. zástupce ŘZ
Ing. Řehát Jan

Business Manager

11 / 79	Tech.administrat. pracovník
4	Vránová Radana

Technician

14 / 65	Pracovník odbytu-podnik.prodejna
8	Mládenka Josef

Chief of external Trade

29 / 99	Ved.odd.zahraničí prodeje
11	Mgr.Štembírek E.

31 / 65	Pracovník odbytu - prod. zahran.
10	Ing. Rusina Jiří

32 / 65	Pracovník odbytu - prod. zahran.
9	Ing.Křivon Radim

33 / 65	Pracovník odbytu-prod. zahraničí
9	Ing.Fierla Jerzy

34 / 65	Pracovník odbytu-prod. zahran.
9	Ing.Boczek Roman

35 / 65	Pracovník odbytu prod. zahraničí.
9	

36 / 65	Pracovník odbytu - prod. zahran.
7	Mrockova Ilona

Chief of Price Dep.

37 / 99	Ved.odd.cen a zasílatelství
9	Ing.Gu[illegible]ilová Dag.

38 / 24	Pracovník tvorby cen - rozhodčí
8	Ďurišová Alena

39 / 24	Pracovník tvorby cen - rozhodčí
6	Ďurišová Martina

Chief of Servic

40 / 99	Ved. oddělení OTS a servis
10	Vondrák Rostislav

41 / 65	Pracovník odbytu - OTS a servis
8	Pietraszková Ot.

42 / 65	Pracovník odbytu - OTS a servis
8	Cieslar Jiří

Quality Control

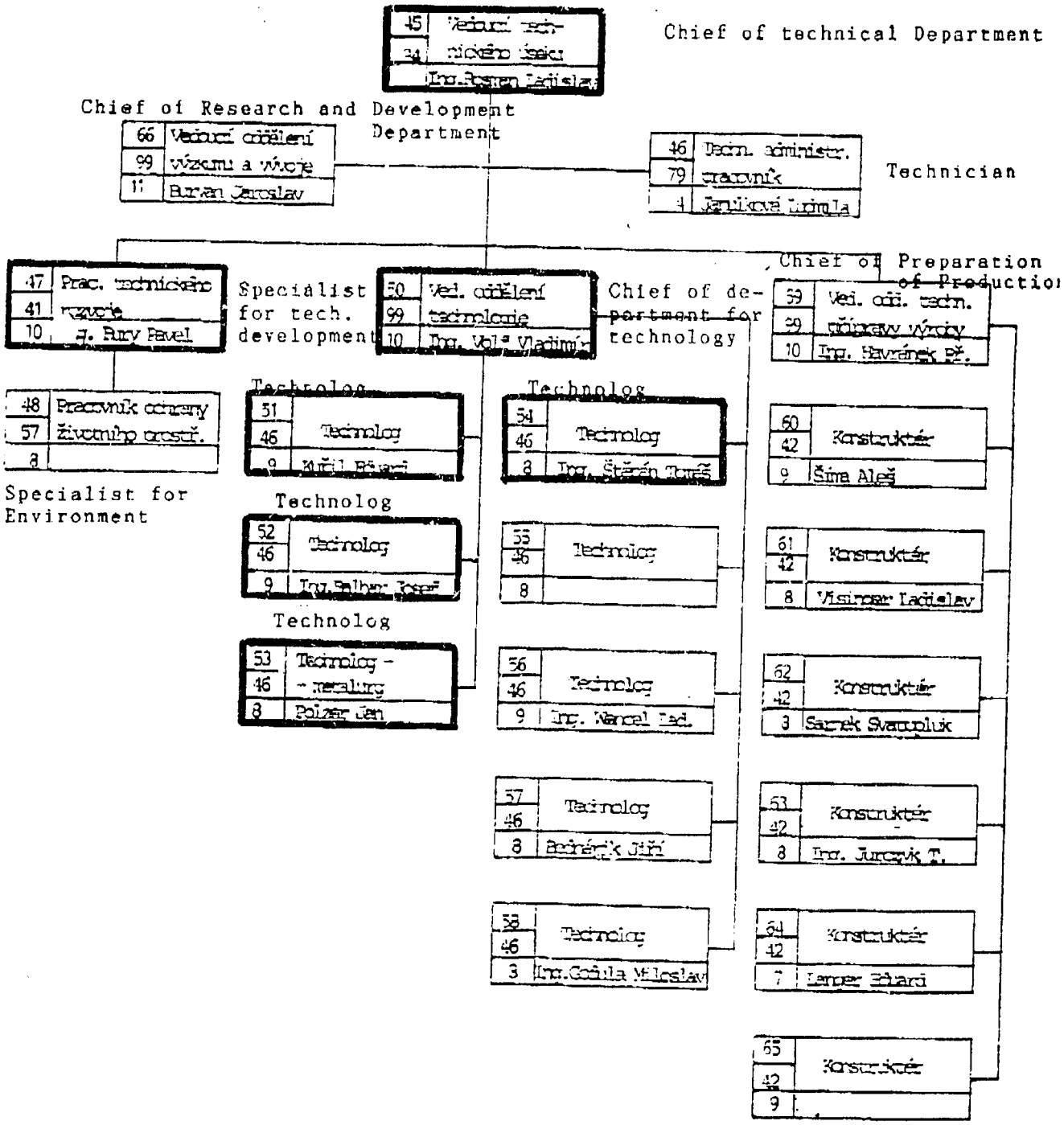
43 / 54	Prac. řízení a kontrol. jakosti
8	Bešniarová Marcela

44 / 54	Prac. řízení a kontrol. jakosti
7	Michalík Vladimír

Stav:	35
Účinnost:	1. 1. 1995

VII-4

Registrační číslo:	090
Strana:	4

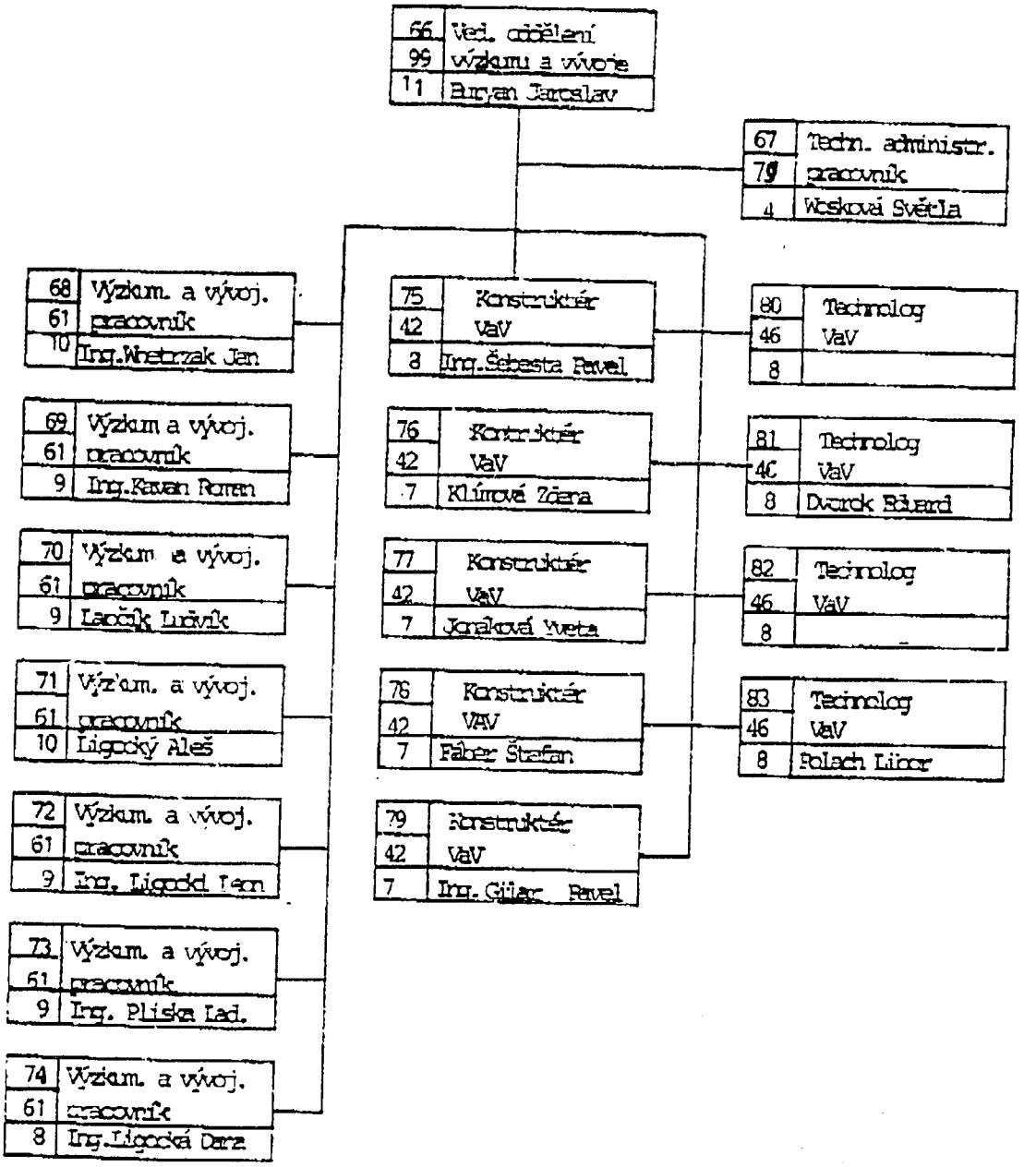


Stav:	20
Účinnost:	1.1.1995

VII-5

Registrační číslo:	090
Strana:	5

Chief of Research and Development Department



Stav:	18
Účinnost:	1.1.1995

VII-6

Registrační číslo:	090
Strana:	6

Chief of Dep. for Economy

84	Vedoucí
94	ekonomického úseku
	Ing.Michalik Jar.

85	Vedoucí oddělení
99	ekon.. kontroling:
3	

49	Programátor -
06	- analytik
10	Ing. Ivanov Ivan

86	Pracovník racio-
21	nalizace - plán.
7	Bojková Jana

164	Programátor -
06	- analytik
10	

87	Pracovník racio-
21	nalizace - plán
7	Sikorová Iveta

88	Vedoucí oddělení
99	účtárny
10	Ing.Zlámalíková L.

95	Rozborář
27	
10	Ing.Hlaček Lumír

98	Vedoucí oddělení
99	oceňování
10	Pěnzně Milan

89	Účetní
29	
5	Mareňková Blažena

96	Kalkulant
25	
8	Korkolová Alena

99	Normovač
22	
9	Vlkovalová Marie

90	Účetní
29	
8	Maroniková Iveta

97	Rozborář
27	
8	Ing.Szaurc E.

100	Normovač
22	
9	Červeňová Květos.

91	Účetní
29	
6	Ličková Blanka

92	Účetní
29	
7	Václavíková Jolana

93	Statistik
32	
5	Řeřová Eva

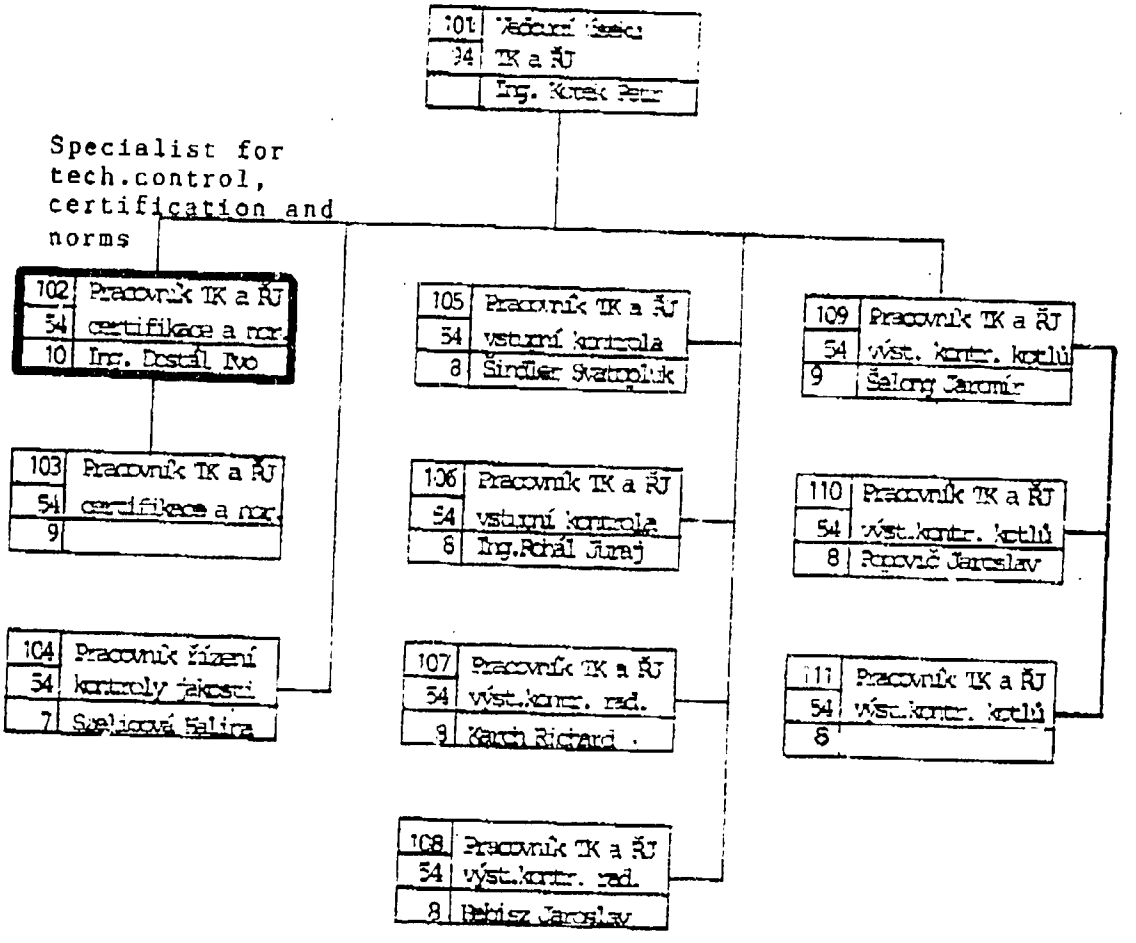
94	Rozborář
27	
7	Solářová Radana

Stav:	19
Účinnost:	1.1.1995

VII-7

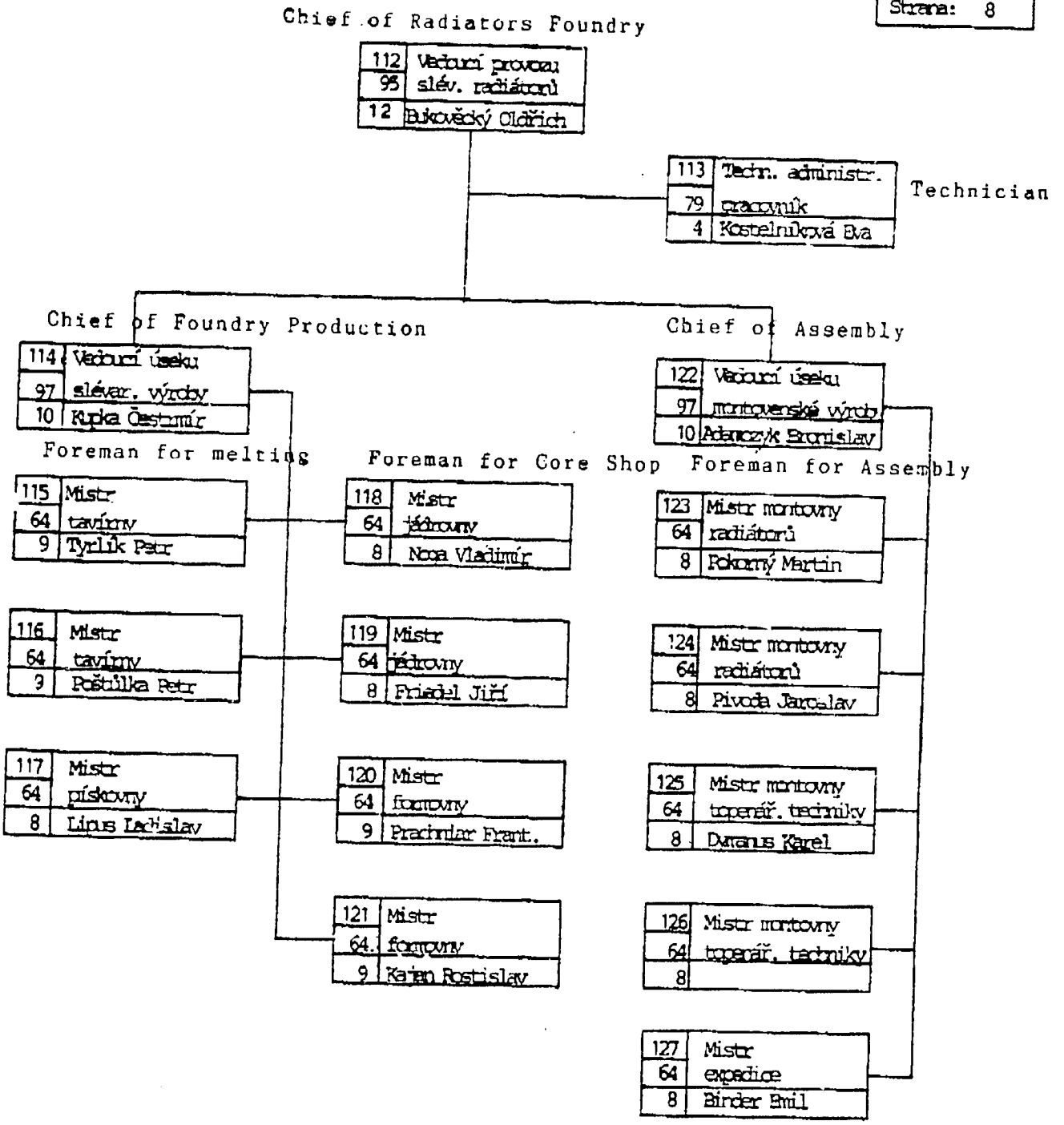
Registrační číslo	090
Strana:	7

Chief of Tech. Control Dep.



Stav:	11
Účinnost:	1.1.1995

VII-8



Podřízenost úseku viz organizační schéma výrobního úseku na str. 2.

Stav: 16

Účinnost: 1.1.1995

102

Registrační číslo:	090
Strana:	9

Chief of Boilers Foundry Operation

128	Vedoucí provozu
95	slévárna kotlů
12	Ing. Šalbut Rudolf

129	Techn. administr.
79	pracovník
4	

Chief of Foundry Production

130	Vedoucí úseku
97	slévárenské výroby
10	Ing. Čáo Miroslav

Foreman for melting operation

131	Mistr
64	tavírny
9	Magginek Petr

132	Mistr
64	tavírny
9	Žaďník Tomáš

133	Mistr pískovny
64	a jádrovny
8	Dymerus Daniel

134	Mistr formovny
64	kotlů
9	Maráček Jiří

135	Mistr formovny
64	armatury
9	Bolard Eduard

136	Mistr cídírny
64	armatury
9	Sůkora Ladislav

Chief of Assembly

137	Vedoucí úseku
97	montovenské výroby
10	Ing. Svoboda Jiří

Foreman for machining shop

138	Mistr
64	obrobny
8	Holuša Dušan

139	Mistr
64	obrobny
8	Gryc Libor

140	Mistr
64	obrobny
8	Smital Čestmír

141	Mistr
64	obrobny
8	Wykydal Roman

Foreman for Assembly

142	Mistr montovny -
64	manip. a skladování
8	Dobrovolný Jaroslav

143	Mistr montovny -
64	příprava výroby
8	Procházka Jiří

144	Mistr opracování
64	armatury a sklad NP
8	Chrastina Pavel

145	Mistr montáže
64	malých kotlů
8	Maňčar Rostislav

146	Mistr montáže
64	ostatních kotlů
8	

147	Mistr mont. ctop.
64	cílírků a zdiví
8	Adamczyk Hubert

148	Mistr
64	exercice
8	Cholevík Rudolf

Podřízenost úseku viz organizační schéma výrobního úseku na str. 2.

Stav:	21
Účinnost:	1.1.1995

VII-10

Chief of cast steel foundry

149	Vedoucí provozu
95	slév. ocelolitiny
10	Ing. Nemička J.

150	Mistr slévárny
64	ocelolitiny
9	Koplík Michal

151	Mistr slévárny
64	ocelolitiny
9	Ing.Samlík Mlr.

152	Pracovník odbytu a
65	expedient
6	Karlová Zdeňka

Chief of modeling operation

153	Vedoucí provozu
95	modelárny
10	Kalisch Jiří

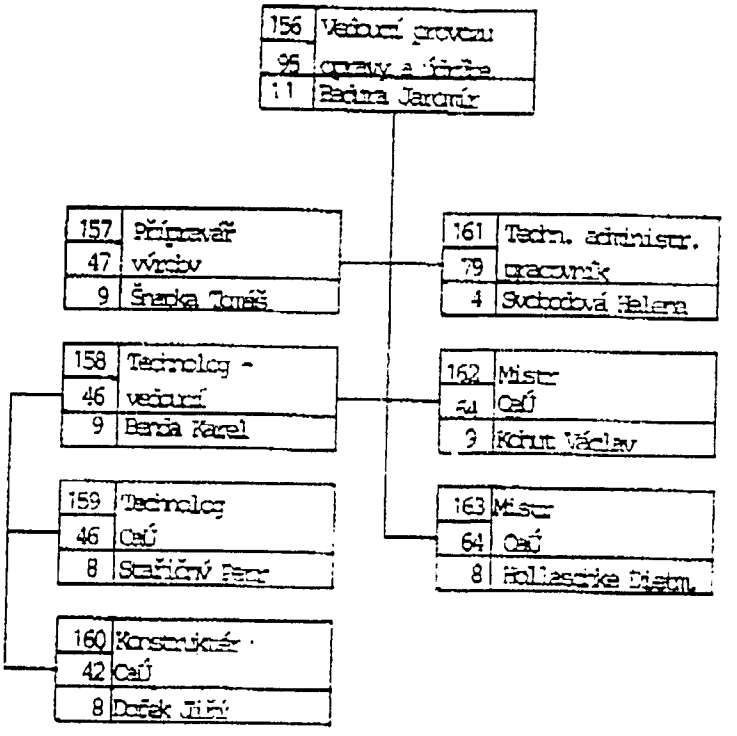
154	Mistr
64	dřevomodelárny
8	Polke Petr

155	Mistr
64	kovomodelárny
8	Kocur Jiří

Foreman for metal pattern

Podřízenost úseku viz organizační schéma výrobního úseku na str. 2.

Chief of Repair and Maintenance Department



Podřízenost úseku viz organizační schéma výrobního úseku na str. 2.