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United States Agency for International Development

INVESTIGATION OF WAYS TO REDUCE SOLID WASTE AND CONTROL POLLUTION AT THE ROMPLUMB LEAD SMELTER

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Prepared for:
S.C. Romplumb S.A.

June 23–July 11, 1996

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June 23–July 11, 1996

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ACRONYMS

EAPS	Environmental Action Programme Support
EAPS team	Richard Daniele, Melvin Sharp
EHP	Environmental Health Project
GOR	Government of Romania
IMNR	Institute for Non-Ferrous and Rare Metals
IR	Intermediate result
Romplumb	S.C. Romplumb S.A.
SO_2	Sulfur dioxide
SOW	Scope of work
USAID	U.S. Agency for International Development
USEPA	U.S. Environmental Protection Agency

UNITS OF MEASURE

cm	Centimeter
g/Nm^3	Grams per normal cubic meters
gpl	Grams per liter
kg	Kilogram
m	Meter
m^2	Square meter
m^3/hr	Cubic meters per hour
mg/Nm^3	Milligrams per normal cubic meter
Nm^3/hr	Normal cubic meters per hour
ppm	Parts per million
t	Metric tonne
tpd	Metric tonnes per day
tph	Metric tonnes per hour
tpm	Metric tonnes per month
tpy	Metric tonnes per year
$\mu g/Nm^3$	Micrograms per normal cubic meter

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SECTION I

INTRODUCTION

SECTION I
INTRODUCTION

A. Introduction

A team of the Environmental Action Programme Support (EAPS) project, in cooperation with the Environmental Health Project (EHP) and the United States Environmental Protection Agency (USEPA), developed a framework for an integrated environmental program in Romania. This framework has been modified into specific work plans for the S.C. Romplumb S.A. lead smelter (Romplumb) in Baia Mare, Romania.

The EAPS project is entering its second year of providing technical assistance and grant procurement to the Romanian nonferrous metals industry. Activities for the current year support the strategic objectives of the United States Agency for International Development (USAID), particularly strategic objective assistance area III: social stabilization (ENI objective 3.3), which aims to reduce environmental risks to public health.

In 1992, a joint environmental strategy mission identified 14 hot spots, or severely polluted areas in Romania. The heaviest sources of pollution in these hot spots are state-owned industries. USAID is pursuing state-owned hot spot industries by means of strategic objective 3.3, reduced exposure to contaminants in severely polluted areas.

Strategic objective 3.3 has the following intermediate results (IRs):

IR1: Industrial Emissions Reduced
IR1.1: Improved Operations in Polluting Plants
IR1.1.1: New Technologies, Methods, and Practices Used
IR1.2: Modern Industrial Capital Investment in Polluting Industries
IR1.3: Environmentally Sustainable Industry Restructuring Plans

Because antiquated equipment, production, and management techniques are a major constraint to reducing industrial emissions, the framework casually links IR1.1.1 to IR1.1. IR1.1 directly contributes to IR1 and IR1.2. IR1.2 refers to the need to invest in more efficient pollution abatement equipment to reduce industrial emissions. Thus, IR1.2 also contributes directly to IR1. IR1.3 refers to the requirement to develop industry restructuring plans as a prelude to making their operations more efficient and therefore more environmentally benign.

In support of strategic objective 3.3, IR1 should reduce exposure to contaminants and improve the economic viability of assisted Romanian plants. "Supporting IR1 should also contribute to the increased productivity and long-term viability of assisted plants. . . . It is assumed that this economic benefit . . . will be sufficient motivation for the state-owned industries to be less polluting."

Thus, if the EAPS project improves operations, technologies, methods, and practices, it will reduce pollution in the Romplumb plant. The EAPS project encourages capital investment in equipment and encourages environmentally sustainable restructuring plans through which Romplumb can become economically viable.

A1. Purpose

The purpose of this assignment in Baia Mare, Romania, was for Richard Daniele, Dames & Moore, and Melvin Sharp, Chemonics contract employee, to initiate action on the 1996–1997 Work Plan for Romplumb lead smelter, Draft June 18, 1996, as outlined in their scope of work (SOW) for Romania, June 17, 1996, to July 19, 1996. As part of their SOW activities, Messrs. Daniele and Sharp (EAPS team) observed the lead smelter operations, including sintering, blast furnace, and lead refining operations. They participated in extensive discussions on smelter operating practices, problems, and need for reducing solid waste (matte) problems and obtaining new raw materials.

A2. Objective

The 1996–1997 program for Romania is ambitious, requiring a focused and intense approach to achieve desired results. Activities to be conducted by Messrs. Daniele and Sharp were intended to concentrate on specific high-priority tasks identified in the Romplumb 1996–1997 work plan and their SOW. The EAPS team objectives were to initiate implementation of tasks 3 and 4, as discussed in Sections IV and V.

A2a. Task 3: Solid Waste (Matte) Reduction and Copper and Lead Recovery

The first objective was to investigate ways to reduce solid waste (matte) by observing how feed preparation, sintering, and blast furnaces processes result in the high copper/lead matte. The Romplumb lead smelter generates an intermediate product containing too much copper for a lead smelter and too much lead for a copper smelter. Improvements in operating practices would reduce the quantity of matte produced, while treating the entire matte could generate lead and copper products that could be smelted, respectively, by Romplumb and a copper smelter such as S.C. Phoenix S.A. Treating the matte would reduce or eliminate a potential environmental problem, improve Romplumb's economic condition, and allow it to invest in other environmental improvements. Task 3 identifies and implements improvements in operating processes to reduce solid waste and recover copper and lead with the following SOW-specified goals:

- Develop a request list for solid waste (matte) information, including its composition, to be submitted to Romplumb before arrival at the site
- Develop a list of treatment technologies most appropriate for the solid waste (matte)
- Evaluate process flowsheets and material balances for treatment of solid waste (matte) and suggest process improvements
- Make a preliminary selection of equipment for treating the solid waste (matte)

A2b. Task 4: Smelter Operation Practice Evaluation and Pollution Control Improvement

Task 4 involves the evaluation of current operating practices to improve pollution control and waste reduction, including recovery of metals from in-plant wastes, with the following SOW-specified goals:

- Develop a request list for smelter operation information to be submitted to Romplumb before arrival
- Perform a preliminary evaluation of the current operations at the smelter
- Evaluate the environmental benefits of updating the plant

Implementation of "Technical Assistance is required to evaluate operating practice to improve pollution control and waste reduction including recovery of metals from in-plant wastes. This will improve operating practices to include better process control for waste reduction and recycling of in-plant wastes."

B. Report Organization

This report is organized into five sections. Section I introduces the scope, purpose, and objectives of the assignment. Section II provides background on the Romplumb facility. Section III describes the approach to tasks 3 and 4. Section IV presents the findings on task 3, waste (matte) reduction and copper/lead recovery, including approach, results, conclusions, and recommendations. Section V presents the findings on task 4, smelter operation practice evaluation and pollution control improvement, including approach, results, conclusions, and recommendations.

SECTION II

BACKGROUND

SECTION II
BACKGROUND

A. Introduction

The S.C. Romplumb S.A. (Romplumb) lead smelter is in the City of Baia Mare, Maramures Prefect, in the northern regions of Transylvania in Romania. Romplumb processes copper-lead concentrates and other metallurgical byproducts, particularly lead-copper residues from the lead and zinc smelting complex of Sometra S.A., in Copsa Mica, Romania. Until 1990, Romplumb was a larger operation and produced products such as copper-free lead, copper matte, manganese dioxide, secondary lead from battery scrap, and castings of pig-iron, steel, and nonferrous metals. After 1990, the range of products produced at Romplumb was reduced to copper-free lead, lead- and copper-containing matte, and castings of pig-iron, steel, and nonferrous metals. Currently, Romplumb produces copper-free lead and a matte containing lead and copper. The matte is no longer saleable; it contains too much copper for a lead smelter and too much lead for a copper smelter.

Romplumb's operation is presented in the following four sections:

B. Smelter Description
C. Current Production
D. Environmental Concerns of Current Operations
E. Personnel Capabilities

B. Smelter Description

The Romplumb lead smelter was built more than 40 years ago. The first furnace, a 3.6-square meter (m^2) unit, was commissioned in 1954. A second 5.6 m^2 furnace was commissioned in 1983. Today, the Romplumb smelter is in a unique and difficult position in Romania. Romania does not produce sufficient lead concentrate to operate both Romplumb and the much larger Sometra lead and zinc smelting complex in Copsa Mica. Romplumb is therefore unable to obtain a sufficient quantity of lead concentrate. Romplumb's basic raw materials are lead concentrate with greater than 1 percent copper, as Sometra will not take lead concentrates with more than 1 percent copper. Today, Romplumb operations consist of feed preparation, sintering, blast furnace operation (called a water jacket furnace by Romplumb), and lead refining. Photographs taken in the smelter are in Annex A of this report, and plant and sintering/smelting flowsheets are in Annex B.

B1. Feed Preparation

New lead concentrate to Romplumb represents approximately 40 to 45 percent of the raw materials handled in the feed preparation area. New and recycled raw materials are delivered to the feed preparation area in trucks, railroad cars, and transportable containers. These materials are transported from the storage area by conveyer to 10 storage bins. Each bin has its own disk feeder, which allows operators to control the mixture. The materials are discharged from the bins in desired proportions to prepare the mix for the sinter machine. The key process element in the primary lead smelter is producing good sinter for the blast (water jacket) furnace. Good sinter is produced by having a properly prepared and sized charge delivered to the sinter machine.

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In normal sintering operations to prepare feed for the blast furnace, lead concentrate is mixed with slag, return sinter, and fluxing agents (slag-forming additives). The mixture is agglomerated or pelletized before sintering. The feed preparation system at Romplumb provides for mixing but not agglomerating or pelletizing ahead of the sinter machine. This results in a fine mass of material being discharged to the sinter machine, leading to poor porosity.

The blended charge to the sinter machine is transported through a drum humidifier to add moisture to the sinter feed (photographs 1 and 2, Annex A). The drum humidifier is 1.3 meters (m) in diameter, 4.0 m long, and has a capacity of 50 tonnes per hour (tph). The purpose of adding moisture is to leave voids within the sinter as the water evaporates to increase sinter bed porosity.

B2. Sintering

Romplumb has two Dwight Lloyd circular sinter machines. These machines (photograph 3, Annex A) are unusual in that most sinter machines are built in a straight line. Nevertheless, the operating principle is the same for the circular and linear machines. Raw materials are added to the sinter machine at a point ahead of the ignition box. The purpose of the ignition box is to ignite the sulfur in the sinter mix and cause the sulfur to oxidize to sulfur dioxide (SO_2). Once the sulfur is ignited, the burning reaction raises the temperature of the raw material. The temperature is raised to continue burning the sulfur and initiate a reaction between the lead and the silica fluxes. This reaction produces lead/oxygen/silica compounds and lead/iron compounds to produce a hard, granular sinter product. To sustain the chemical reactions, air is drawn through the raw material bed on the sinter machine. The air can be drawn through the mass of material either in an upflow or downflow direction. Romplumb has a downflow sinter machine. The SO_2 gases, along with fine particulates, are drawn away from the sinter machine and into the pollution control system.

The sinter bed is 20 to 25 centimeters (cm) thick and, on ignition, reaches temperatures ranging from 700°C to 900°C. Air is introduced to the sinter machine bed at the rate of 26,000 to 28,000 cubic meters per hour (m^3/hr). An important function of sintering is to remove sulfur to the greatest extent possible. If sulfur is not removed in the sintering process, it will remain in the sinter as metal sulfides and/or metal sulfates ($PbSO_4$ at $<700°C$) or in a form that will react with metals in the next stage of the lead-smelting process, the blast furnace. When copper materials are present in the sinter raw material, they tend to retain sulfur and produce the intermediate product matte, a lead/copper/iron/sulfur mixture, in the blast furnace.

Each sinter machine has a 28 m^2 circular grate area. Approximately 270° of the circular sinter grate is active in Romplumb's sintering process. The sinter grate works at a constant speed, which is one revolution per 70 minutes. The expected productivity of Romplumb's machine is 5 tph but, in actuality, is only 3 to 4 tph. The speed has been decreased (time per revolution increased) from 55 minutes per revolution to 70 minutes in an attempt to improve sinter quality.

The sinter is manually removed from the sinter machine and transported to the blast furnace area in small, manually pushed ladles called wagonettes (photograph 4, Annex A). All of the process products are handled in very small amounts in the wagonettes, which have roughly one-tenth the volume of those in lead plants in the United States, Canada, Australia, and modern areas of Mexico. The sinter is moved from the wagonettes to a pit area where it is manually crushed. The largest piece sent to the next stage, the blast (water jacket) furnace, is 10 cm in its longest direction.

B3. Blast (Water Jacket) Furnace

Romplumb has two blast furnaces, but only one is operated at a time. Blast furnace size and capacity are generally referenced in terms of cross-sectional area. Romplumb's two blast furnaces have cross-sectional areas of 3.6 and 5.6 m^2. Only the smaller furnace is currently operated; it has been 20 years since both blast furnaces were operated simultaneously. The raw material is generally a mixture of lead sinter, coke, and flux, which is added in layers. The coke reduces the oxidized lead back to lead metal, while the flux, generally a silica or silica and limestone material, aids in producing a fluid slag. At Romplumb, other material, such as recycled matte, slag, and lead wastes are added. The raw material is introduced (charged) at the top of the blast furnace, which is a vertical, oblong chamber, and slowly moves down into the reaction zone near the base of the blast furnace. There, blowing air ignites the coke, generating temperatures sufficiently high to melt the blast furnace charge. The temperature at the top of the blast furnace is approximately 200°C and, in the reaction section, approximately 1,500°C. The blast furnace has four products: lead bullion, slag, matte, and process off-gases containing particulate and some SO_2. Around the outside of the blast furnace is an air header, which carries the blowing air for burning the coke. At Romplumb, this header is subdivided into 52 smaller pipes called tuyeres. Air enters the reaction chamber through the tuyeres.

Gravity separates the slag, matte, and lead bullion in the blast furnace. The slag is lighter and remains near the top, the matte is intermediate weight and settles in the middle, the lead is the heaviest and settles on the bottom of the blast furnace. The lead bullion is tapped (removed) through a crucible at the bottom of the blast furnace. Slag and matte are skimmed through a taphole into a settling chamber where the slag rises and the matte settles (photograph 5, Annex A). The slag is removed by skimming into a stream of water, and the granulated slag is settled in a concrete pit for water recovery (photograph 5, Annex A), slag removal, and recycling. The matte is tapped into small, conical-shaped pots, similar to the wagonette, that can hold approximately 500 kilograms (kg) of matte.

Because of the sintering problems, 25 to 30 percent of the lead charged to the blast furnace is contained in the matte, reducing the amount of bullion produced. In addition, the matte can contain 11 to 18 percent copper and 12 to 29 percent lead. More than twice the desired amount of matte is produced. A good operation with Romplumb-type materials might produce 30 tonnes per day (tpd) of matte, containing 30 to 35 percent copper, whereas Romplumb produces 70 tpd matte with 11 to 18 percent copper. Romplumb produces more matte than other plants largely because the sinter from the sinter machine contains as much as 6 percent sulfur rather than the typical 1 or 2 percent.

The lead bullion is tapped into molds with a capacity of approximately one tonne. The lead is cooled and then transported to the refining department.

B4. Lead Refining

At Romplumb, lead is refined in a separate building at a second-floor level. Current production of lead requires the use of only one 100-tonne-capacity lead kettle. Lead kettles are hemispherical, steel vessels supported inside a refractory furnace. The refractory furnace is heated with burners. The high-temperature gases generated in the refractory furnace heat the exterior of the kettle to a temperature sufficiently high to melt the lead in the kettle. The refining stage removes impurities from the lead bullion.

In Romplumb's case, copper is the only impurity removed from the lead bullion. The lead is refined by controlling the temperature and adding sulfur to produce dross. Dross is a material that has a higher melting point than the lead and floats on its surface. When sulfur is added to the impure lead bullion, it reacts with the copper to produce copper sulfide, which has a higher melting point than the lead. The copper sulfide dross rises to the surface of the lead and is removed. Romplumb's final lead product is a lead bullion with less than 0.07 percent copper and a total lead content of 96 to 97 percent. The remaining impurities are antimony and bismuth (~2% Sb, ~0.5% Bi).

The lead concentrates that Romplumb receives also contain quantities of the precious metals gold and silver. These metals follow the lead smelting process all the way to the bullion. In the United States, pyrometallurgical techniques are used to remove precious metals from the bullion. Romplumb ships its lead bullion to Sometra, which has an electrolytic refinery. In an electrolytic refinery, electric current travels between an anode and a cathode, causing the lead to move from anode to cathode. The result is a 99.9+ pure lead cathode. The impurities from the anode, primarily precious metals, antimony, and bismuth, are collected as sludge when electrolytically refining Romplumb bullion.

C. Current Production

The Romplumb lead smelter has the equipment capacity to produce 20,000 to 25,000 tonnes per year (tpy) of lead bullion, but it currently produces only 50 percent of this, 10,000 to 12,000 tpy of lead bullion. The two main reasons why Romplumb's production is below capacity are problems with the sinter machines and a lack of raw materials. Problems with the sinter machine operation are the smelter's greatest single obstacle. The problem stems from the fact that material discharged onto the machine is so fine that proper operation is not possible. Air does not pass through the feed material, residual sulfur remains in the charge, the charge is not properly sintered, and the resultant sinter chemistry causes excessive matte production. The second reason for Romplumb's low production is the lack of good quality lead concentrates. Generally, lead concentrates contain 60 to 70 percent lead, but Romplumb's only contains 50 to 60 percent. The concentrate also contains comparatively high quantities of copper (i.e., 1 to 4 percent versus a typical concentration of less than 1 percent). These problems result in other downstream operational problems that have kept Romplumb from producing as much lead as its equipment capacity allows.

To overcome a lack of raw materials, Romplumb managers would like to recycle used automotive batteries. Recycling batteries or battery manufacturing waste would have a positive impact on Romplumb in three areas. First, recycling batteries would increase lead production. Second, the lead sulfate and lead oxide materials from automotive batteries would provide a high-lead feed material with low sulfur for the sinter machine. Third, processing lead and lead alloy components from automotive batteries would give Romplumb the opportunity to produce directly saleable refined lead.

D. Environmental Concerns of Current Operations

The sinter machines do not operate properly to produce good sinter. Poor operating characteristics of the sinter machines are a major contributor to the environmental health problems at Romplumb, the smelter's biggest environmental problem. The particulate dust that goes into the sinter machine process off-gas system is excessive, resulting in large quantities of dust during production. This dust recirculates back to the smelter, replacing new feed materials.

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Another problem is poor porosity in the sinter charge. Due to poor porosity, there are high SO_2 emissions into the sinter machine area. Poor porosity causes SO_2 to evolve at the ignition box instead of being drawn into the pollution control system. The sinter machine pollution-control equipment overloads with fine dust, causing backpressure at the sinter machine. Backpressure reduces the effectiveness of drawing the particulate and off-gases containing SO_2 into the system.

The poor sinter quality carries forward to blast furnace operation in two ways. First, sinter quality increases the sulfur in the feed material to the blast furnace, which is transformed into SO_2. Second, poor sinter quality causes more fines to be fed to the blast furnace, which ends up as particulate in the pollution-control system. Two sources of SO_2 with approximately equivalent concentrations results from poor sinter: one is the sinter machine, the other is the blast furnace. Environmental problems result when two SO_2 sources must be evaluated for treatment instead of one in a properly operating system. For example, Romplumb's sinter machine off-gases are approximately 0.5 to 0.65 percent SO_2 by volume, and the blast furnace off-gases are 0.2 percent SO_2 by volume. A properly operating sinter machine may have 10 times as much SO_2 from the sinter process off-gases than from the blast furnace.

When Romplumb installed new Dalamatic baghouses several years ago, it reduced its particulate emissions to the point that the black plume discharge from its 80 m stack built in 1965 was eliminated. Today, the stack has no visible emissions. Romplumb's current SO_2 emission is approximately 240 to 245 grams per second. According to Romplumb sources, such an SO_2 emission level still meets current ambient air criteria. Romplumb's particulate emission is 174 grams per second, with a 0.69 grams per second lead portion. The lead content of the particulate controls Romplumb's particulate emission requirements at this time.

Before 1993, Romanian regulations applied only to ambient air conditions. The Government of Romania (GOR) issued new ambient air standards in 1987, setting 250 micrograms per normal cubic meter ($\mu g/Nm^3$) of SO_2 in the ambient air. In 1993, the GOR issued Order No. 462, which set a new standard of 500 milligrams per normal cubic meter (mg/Nm^3) SO_2 (0.5 g/Nm^3 = 180 ppm SO_2) for in-stack emissions.

The current volume of gases discharged through the Romplumb smelter stack is approximately 150,000 to 200,000 m^3/hr. At an estimated 240 to 245 grams per second SO_2 emission rate this is equivalent to 4,300 to 5,900 milligrams per cubic meter (mg/m^3). The calculations indicate that Romplumb's SO_2 emission is approximately 10 times the in-stack standard.

E. Personnel Capabilities

Extensive discussions were held with Romplumb managers and technicians. Liviu Dumitrean, production director, is an exceptionally qualified lead metallurgical engineer who demonstrated an extensive knowledge of lead metallurgy by developing ideas to improve lead sinter chemistry through metallurgical approaches. However, another key component in obtaining good lead sinter is charge preparation, an issue that is yet to be addressed. Interactions with Mr. Dumitrean and the other smelter supervisory personnel revealed that they have had limited exposure to plants similar to Romplumb where basic problems encountered in lead smelters have been solved.

SECTION III

SCOPE OF WORK TASKS FROM WORK PLAN

SECTION III
SCOPE OF WORK TASKS FROM WORK PLAN

The scope of work (SOW) for Romania, June–July 1996, for Richard Daniele and Melvin Sharp (EAPS team) at Romplumb was to implement task 3, solid waste (matte) reduction and copper and lead recovery, and task 4, smelter operation practice evaluation and pollution control improvement.

Task 3 is presented in Section VI and task 4 is presented in Section V. Each section covers the following:

- Methodology of approach
- Results
- Conclusions
- Recommendations for improved performance with environmental and/or production benefits
- Scheduling of future activities

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SECTION IV

TASK 3 — WASTE (MATTE) REDUCTION AND COPPER/LEAD RECOVERY

SECTION IV
TASK 3 - WASTE (MATTE) REDUCTION AND COPPER/LEAD RECOVERY

A. Methodology of Approach

The methodology of approach on solid waste (matte) reduction and copper and lead recovery was a combination of written documents, multiparty discussions, and multiple visits to the lead smelter. Written documents included the Romplumb Plant Flowsheet Sintering/Smelting Flowsheet (Annex B), and the EAPS Team Technical Information Transferred (Annex C). In a preliminary meeting with Romplumb personnel on June 26, 1996, Liviu Ionescu, Chemonics' environmental technical advisor, requested information on the plant processes and the matte produced.

The methodology of approach to implement the specific goals as stated in the SOW was as follows:

- Develop a list of treatment technologies most appropriate for the matte
- Evaluate process flowsheets and material balances for treatment of matte and suggest process improvements
- Make a preliminary selection of equipment for treating the solid waste (matte)

B. Results

Romplumb provided detailed information, including smelter flowsheets and matte analyses. Together, the EAPS team and Romplumb personnel discussed in detail the generation of the matte and problems with sales of the matte. The matte is generated as the result of the poor quality of sinter produced by the sinter machines. The quality of sinter is deficient in both physical and chemical properties. Physically, the sinter should be a hard, solid mass of material rather than soft and crumbly. Chemically, the sinter contains sulfur in the 4 to 6 percent range, rather than the typical range of 1 to 2 percent.

The feed materials to the Romplumb sinter machine are high in copper compared with most sinter machine feeds. Specifically, the copper concentration in the lead concentrate ranges from 1 to 4 percent copper, compared with typical concentrations of less than 1 percent. Because of poor porosity, the sinter machine does not remove a sufficient amount of sulfur. When the high-sulfur sinter is processed in the blast (water jacket) furnace, an intermediate product (matte) is produced. The matte contains too much copper to be recycled to the lead smelter and too much lead to be sent to the Ampellum S.A. copper smelter in Zlatna.

Table IV-1, Matte Analyses, presents the results of 12 different matte samples. A review of Table IV-1 indicates the wide variability in lead and copper content in the matte. Romplumb estimates 25 to 30 percent of the smelter lead is contained in the matte; therefore, it is not recovered. Currently, the matte is being accumulated and stored on the Romplumb smelter site. The storage pile may hold several thousand tonnes of matte.

Table IV-1. Matte Analyses (Weight %)

Source	Pb	Cu	Fe	S	Zn	Au (gpt)	Ag (gpt)
Nov 11, 1995 Letter	13-17	15-24	34-37	20-22	4-6	0.1-0.3	300-500
Flotation Test	19.07	34	2.96				
Monthly Test (2/96)	19.9	14.14	32.72	10.8	4.88	0.6	615.4
Monthly Test (1/96)	27.0	11.04	27.8	16.9	3.57	0.8	675.2
Blast Furnace Charge	20-30	11-20	20-30	16-20			
July 1995	26.7	13.2	29.4	12.5	3.5	0.6	
August 1995	24.0	12.2	30.9	17.9	3.9	0.8	
September 1995	26.8	18.2	30.5	14.6	3.6	0.8	
October 1995	28.6	16.9	30.0	15.3	3.9	0.6	
November 1995	16.1	15.9	36.7	13.3	4.9	0.8	
December 1995	12.0	16.8	30.5	14.2	3.6	.08	
April 1996	24.5	15.3	30.9	15.6	4.4	0.6	

Matte treatment technologies. Discussions were initiated on ways to process the matte. Currently, Romplumb recirculates approximately 50 tpd of matte to the blast furnace. This quantity of matte ranges from 20 to 33 percent of the blast furnace charge, depending on the percent of the other components. When the matte is removed from the blast furnace (tapping), it is discharged into 500 kg ladles. The ladles are conical with a top diameter of 1140 cm and a total depth of 560 cm. The small pots are allowed to cool in the ambient air. When sufficiently cooled, the matte is dumped from the pot into a pile and manually broken up with a sledgehammer. Pieces are selected for recycling back to the blast furnace and the remainder is moved to the storage area.

Four approaches for treating the matte were discussed as follows:

- Recycling some of the matte to the sinter machine
- Flotation to separate the copper sulfide from the lead sulfide
- Hydrometallurgical processes including biological leaching and chemical leaching
- Pyrometallurgical processing

Recycle matte. Mr. Dumitrean believes that the addition of coarse matte to the sinter machine would aid in producing better sinter by improving both the charge porosity and the sinter bed chemistry. Matte would be charged by placing a 3 to 5 cm layer on the sinter machine grates before the addition of other sinter feed materials. By using matte in the 0.5 to 1.0 cm size range, the sinter bed porosity is expected to increase, burning additional sulfur and generating higher temperatures. This would result in improved fusion of the sinter bed and produce a hard, solid product. Burning additional sulfur would reduce the quantity of matte produced.

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Forensic optical mineralogy. A first step in choosing a metallurgical process is to know the compounds present in the material and their respective particle sizes. Using forensic optical mineralogy to analyze the matte was discussed. Two samples of matte were obtained for forensic optical mineralogy evaluation by a U.S. laboratory. At the EAPS team's request, one sample was selected from the standard cooling method and the other sample was slow-cooled, which entailed leaving the matte in the pot for 24 hours before removing it. The objective of slow-cooling is to produce larger crystal grains of the lead sulfide and the copper sulfide in the matte. Generally, the larger the grain structure, the more effective the metallurgical processing techniques. The optical mineralogy results aid in choosing an appropriate treatment process for the matte.

Flotation. A flotation test was conducted previously on Romplumb matte. The results of this test, presented in Table IV-2, indicate that the flotation was not successful. No other information was provided by Romplumb, however.

Table IV-2. Flotation Test Information (weight %)

Item	Cu	Pb	Fe
Matte	34	19.07	2.96
Concentrate	29.86	16.69	
Tailing	34.73	20.65	

Hydrometallurgical processes. Other processes discussed were hydrometallurgical treatment, including biological treatment and chemical leaching. Biological treatment uses selected bacteria strains to selectively solubilize part of the matte. The specific goal of biological treatment is to remove the copper from the lead, allowing the copper portion to be sold to a copper smelter such as S.C. Phoenix S.A. and the lead portion to be retained by Romplumb for recycling. A typical bacterial approach solubilizes the copper as a copper sulfate and uses solvent extraction to concentrate and purify the copper as a copper sulfate. The copper sulfate could either be produced at Romplumb or the solution could be sold to a copper facility with an electrolytic refinery or copper sulfate production capability.

Two other feasible hydrometallurgical approaches use sulfuric acid or ammonia to leach the copper from the matte. Sulfuric acid, when properly used, can solubilize the copper sulfide as copper sulfate. Ammonia is a good solvent for copper sulfide and, like sulfuric acid, can chemically separate copper and lead.

Pyrometallurgical processes. A pyrometallurgical approach is also feasible. Such an approach consists of blowing air into molten matte in a vessel and adding silica flux to form a slag. Either a small Pierce-Smith converter or Romplumb's small, unused reverberatory furnace could be used as the reaction vessel. In this approach, the lead sulfide is oxidized to lead oxide and enters the slag to process off-gas. Meanwhile, the slag and captured dust from the process off-gas is recirculated to the sinter machine. Oxidation of the molten matte generates three products: the lead oxide-containing slag, a molten copper product with 90 percent or more copper, and process off-gas containing considerable SO_2 and lead oxide particulate.

C. Conclusions

Based on its June–July 1996 visit to Romplumb, the EAPS team reached the following conclusions regarding treatment of the solid waste (matte) to recover copper and lead:

- Using coarse matte to increase the porosity of the sinter bed is a worthwhile operating approach to recycling the matte and improving sinter quality.
- The current method of manually handling the matte creates the potential for high lead compound dust exposure and potential injury from flying particles.
- The compounds present in the matte and their grain size are unknown. Knowledge of these matte components is important in selecting a processing technology.
- Information is insufficient at this initial project stage to develop process flowsheets and material balances. Treatment technologies are limited to selecting types of metallurgical processing for further study. Processing types that should be considered at this stage are flotation, hydrometallurgy, and pyrometallurgy. The hyrdrometallurgical processes that should be considered are microbiological, sulfuric acid, and ammonia leaching.
- After selecting any process flowsheet, metallurgical testing should be conducted.
- The equipment available on-site at Romplumb to minimize capital costs in selecting the process for treating the matte should be evaluated.

D. Recommendations for Improved Performance

Two approaches for treating the matte at Romplumb should be considered. Both approaches require the matte to be crushed. The first approach is to test recycling of a coarse, sized matte on the sinter machines. This approach requires Romplumb to implement changes to operating practices. The second approach is to select technologies for separating the copper and lead in the matte. The EAPS team has made the following recommendations to support the two approaches.

D1. Romplumb Test Recycling of Matte on the Sinter Machines

Romplumb should test recycling of the matte by adding a crushed and screened (sized) quantity of matte to the sinter machine grate ahead of the charge. This would involve placing a 3 to 5 cm layer of 0.5 to 1.0 cm sized matte on the sinter machine grates before the sinter feed.

Technical assistance and procurement. Romplumb can test the recycling of matte without technical assistance or procurement involving EAPS.

Schedule and benefits. Romplumb indicated that it would schedule a test of adding coarse matte to a sinter machine within 30 days after the EAPS team visit. A coarse material on the sinter machine grate has the potential to improve sinter porosity. Improved porosity has two economic benefits: the sinter machine operates at a higher throughput rate and some of the lead in the matte is recovered. It also provides environmental benefits by consuming some of the solid waste (matte), reducing particulate and SO_2 emissions into the work environment, and causing

less particulate carryover into the pollution control system. The current problem of overloading the pollution control system might also be eliminated.

Overall responsibilities. Romplumb has responsibility for conducting the test and evaluating results. Romplumb should also provide the results to EAPS, as they could affect other EAPS activities for solving the matte problem.

D2. EAPS Contract with the Institute for Non-Ferrous and Rare Metals

EAPS should contract with the Institute for Non-Ferrous and Rare Metals (IMNR) to provide engineering for installing a matte crushing system. The site visit indicated that crushed matte should be the first step in any approach to solve the matte problem. The matte crushing system should include crushing, screening, pollution control equipment, and a building, new or existing, to house the equipment.

Technical assistance and procurement. As part of the technical assistance, EAPS would negotiate a contract with IMNR to provide engineering services and obtain pricing information for used crushing and screening equipment in the United States. IMNR would investigate the availability in Romania of used crushers and screens for the matte crushing system. An EAPS contract with IMNR would involve the purchase of services. There could be an opportunity to purchase used equipment in the United States or Romania, which would offer the opportunity for grant funding.

Schedule and benefits. Obtaining information on used equipment is a short-term activity that could be accomplished in one month. Entering into a contractual relationship with IMNR for engineering of a crushing system for Romplumb could be a long-term activity as long as EAPS is providing technical assistance to Romplumb. The process of obtaining used crushing and screening equipment, from initiating the search to installing the system, is a long-term activity, which could last six to eight months.

In whatever approach taken to solve the solid waste matte problem—crushed matte on the sinter machine to improve porosity or a treatment process to recover lead and copper—a crushing system will be needed. Therefore, installing a crushing system has an economic benefit. The environmental benefit of a crushing system is a safer work place with less personnel exposure to flying matte chips and lead dust.

Overall responsibility. EAPS and IMNR would share responsibility for the selection and purchase of equipment and design of the crushing system. Romplumb would be responsible for constructing a crushing system and training personnel to operate it. This activity would contribute toward building capacity within IMNR.

D3. Provide Technical Assistance for Solid Waste (Matte) Treatment Technology

The recommended technical assistance for solid waste (matte) treatment technology includes testing two matte samples obtained from Romplumb and evaluating metallurgical processes. The metallurgical technologies recommended are hydrometallurgical and pyrometallurgical.

The hydrometallurgical technologies recommended for evaluation are as follows:

- Microbiological (bacteria) leaching
- Sulfuric acid leaching
- Ammonia leaching

All three technologies separate copper from the lead in the matte. The three technologies are conceptually similar in that they use bacteria or chemicals to separate the copper from the matte by solubilizing the copper. Once the copper is in solution, a solid/liquid separation can be used to separate the copper from the lead. The lead solid, the residue from the technologies, is returned to the smelter. The copper can either be recovered from the solution or the solution can be sold.

The pyrometallurgical process entails the use of a smelting vessel. The matte is oxidized to allow the lead to enter the slag and process off-gas. The copper remains as copper sulfide or blister copper depending on the amount of oxidation. Generally, blister copper contains 98.0 to 99.6 percent copper. Depending on the equipment chosen, the copper content may only be 90.0 percent, due to operating reasons.

Technical assistance and procurement. The first technical assistance action is to arrange for the forensic optical mineralogy testing of the two matte samples. Testing will determine grain sizes and compounds in the matte. Generally, the larger the grain structure, the more effective metallurgical processing techniques will be. The optical mineralogy results aid in choosing the appropriate treatment process for the matte and requires laboratory services.

The second effort is to provide technical assistance to obtain technical information on the hydrometallurgical and pyrometallurgical processes, review and evaluate the information, present the findings to Romplumb for discussion, and jointly select the technologies for test work. The technical assistance requires investigating processes such as those practiced at Tsumeb in Namibia to separate the lead from the copper in the matte. Because most of the technical assistance is for technology selection, the procurement requirements are limited. Once the technologies are selected for testing, there is an opportunity for laboratory test work. The procurement could involve grant funding if the test work is done in Romania.

Schedule and benefits. The forensic optical mineralogy testing on the two samples has been completed. Based on the testing results, it was concluded that flotation was not a viable technology for separating the copper from the lead in the matte. The technical assistance for selecting testing technologies is a short-term activity that can be accomplished in three months, including the Romplumb review and selection period. Conducting tests is also a short-term activity that can be completed in approximately three months. The evaluation of test results and selection of the process for treating the solid waste (matte) can be completed in a month. The technical assistance for selecting the treatment technology for the matte is a long-term activity of seven to nine months. Installation of the selected technology, depending on the process selected, is a long-term activity of six or more months.

Treating the matte offers the economic benefits of recovering the copper and lead and reducing or eliminating matte recycled to the blast furnace. These benefits, in turn, allow new lead-bearing materials to be fed to the blast furnace, resulting in higher lead production. The major environmental benefit is the elimination of the solid waste (matte). Another environmental

benefit is improved working conditions for handling the matte, compared to the present conditions. Present conditions involve considerable exposure to lead-containing particulates.

Overall responsibility. EAPS would have overall responsibility for the technical assistance for investigating the treatment technologies. EAPS and Romplumb would share responsibility for selecting the technologies for testing. EAPS will have overall responsibility if the test work is conducted in the United States; if the test work is conducted in Romania, EAPS, the testing laboratory, and Romplumb will share responsibility. Romplumb will be responsible if pyrometallurgical testing is conducted in Romplumb's existing small reverberatory furnace. Grant funding for test work in Romania would support sustainability and require shared responsibility.

E. Scheduling of Future Activities

Activities can be initiated immediately on all recommendations. Contact should be made with Romplumb to determine the status of its efforts to add a coarse matte layer to its sinter machine. Once the EAPS technical assistance has completed selecting matte treatment technologies, a review meeting with Romplumb should be held. Romplumb's test results on matte additions to the sinter machine and matte treatment in its reverberatory furnace can be reviewed at that meeting. An objective of such a meeting is to select technologies for test work and develop a schedule for making the final process choice.

Contractual participation by IMNR should be arranged by EAPS as soon as possible. Once IMNR has developed a preliminary flowsheet and general arrangement drawings for a matte crushing system, a follow-up meeting should be held at the Romplumb site.

SECTION V

TASK 4 — SMELTER OPERATION PRACTICE EVALUATION AND POLLUTION CONTROL IMPROVEMENT

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TASK 4 - SMELTER OPERATION PRACTICE EVALUATION AND POLLUTION CONTROL IMPROVEMENT

A. Methodology of Approach

The methodology of approach for task 4, smelter operation practice, evaluation, and pollution control improvement, was a combination of written documents, multi-party discussions, and multiple visits to the lead smelter. Written documents included the Romplumb Plant Flowsheet and Sinter/Smelting Flowsheet (Annex B), and the EAPS Team Technical Information Transferred (Annex C). In a preliminary meeting with Romplumb on June 26, 1996, Liviu Ionescu, Chemonics' environmental technical advisor, verbally requested information on the plant processes, including production and environmental information. The above methodology was used to implement the specific goals, as stated in the SOW:

- Perform a preliminary evaluation of the current operation at the smelter
- Evaluate the environmental benefits of updating the plant

B. Results

The Romplumb lead smelter consists of three major processes: sintering, blast (water jacket) furnace, and lead refining. Each of these processes is supported by pollution control systems for capturing process and hygiene gases. In Romania, the general term used for process gases is technological gases.

A feed preparation system supports the sintering operation. Raw materials are received, stored, and transported to storage bins. Each bin has a proportional feeder for discharging the bin to make a blend of raw materials, called the sinter charge or sinter mixture. Moisture is added to the charge in a drum humidifier ahead of the sinter machine.

The Romplumb operations from the sinter machine through the casting of refined lead product is characterized by a considerable manual labor. Manual labor is used for the following operations:

- Moving sinter from the sinter machine discharge to a storage area
- Reclaiming the sinter from storage and moving it to the top of the blast furnace
- Breaking approximately 500 kg pieces of matte into smaller pieces
- Moving lead bullion cakes to the refining area
- Moving refined lead to the storage area

During these operations, workers must deal with hot, gassy, and dusty materials.

The primary operating problem at Romplumb is that poor quality sinter is produced. Good quality sinter is a hard, abrasive material that requires mechanical breaking to obtain the proper size for the blast (water jacket) furnace. At Romplumb, the sinter has many fines and only a few pieces of hard, stable material. The sinter's poor physical and chemical quality causes problems throughout the lead smelter. Poor chemical qualities result in the production of high quantities of matte, as discussed in Section IV. The poor physical quality of the sinter affects the downstream operation of the blast furnace and pollution control systems in the sintering and blast furnace

operations. Romplumb and the EAPS team concurred that sinter quality is the plant's greatest single operating problem. For that reason, problems concerning sinter quality are described in greater detail below.

The sinter problem begins at the point where the proportional feed mixture enters the drum humidifier (photographs 1 and 2, Annex A). The purpose of the drum humidifier is to add moisture to the lead concentrate and other charge material. In the sintering process, the water should evaporate, leaving voids that improve porosity on the sinter machine. Although proper sinter machine feed material is agglomerated or pelletized, Romplumb's material is neither pelletized nor agglomerated. The EAPS team's observations indicated that the charge to the sinter machine was excessively wet and the charge was put onto the sinter machine as a fine mass. The sinter charge is spread on the sinter machine grates to a thickness of 20 to 25 cm. The consistency of the charge prevents the flow of air through the sinter, with weak air flow resulting in poor ignition of the sinter. Poor ignition, in turn, reduces the amount of sulfur converted from sulfide or sulfate to SO_2 gas. The residual sulfur increases the amount of matte produced in the blast furnace. Poor ignition also causes excessive fine particulate to enter the process off-gas system, resulting in pollution control equipment overload.

The poor porosity in the sinter bed causes SO_2 and dust emissions to reflect off the charge in the ignition box area and enter the ambient atmosphere above the machine. The sinter machine discharges material that contains a high proportion of fines, even after passing over bar screens designed to remove the fines. This indicates the poor strength of the sinter.

Sinter quality has two parts: the physical characteristics of the charge to the sinter machine and the chemistry of the sinter charge. Romplumb adds a wet mass of material to the sinter machine. The desired physical characteristic of sinter feed is a ball or pellet with sufficient strength to survive placement on the sinter machine without decrepetation.

Romplumb believes that adding copper raw materials containing little or no sulfur can improve the chemistry of the sinter charge. The purpose of adding copper would be to capture some of the sulfur that remains in the lead by transferring it to the copper. To accomplish this, Romplumb will try to obtain materials such as copper drosses and copper smelter furnace slag. The chemistry change will affect the blast furnace, with the additional copper in the sinter producing a higher copper-content matte in the blast furnace. The higher copper content in the blast furnace matte could result in a saleable matte.

C. Conclusions

Based on discussions and field observations, the EAPS team has concluded that sinter quality must be improved. The most significant operating environmental problem with the smelter is poor operation due to an improperly prepared sinter charge. This is based on the following conclusions:

- Improving the porosity of the lead sinter charge would reduce particulate and SO_2 emissions into the sinter plant ambient atmosphere.

- Finding a means of agglomerating or pelletizing the charge before it is fed onto the sinter machine is essential for producing good sinter.

- Improving porosity in the charge would allow increased SO_2 capture, reduce particulate fines in the off-gas collection system, reduce the overload of the pollution control system, and reduce the quantity of dust that must be recycled.

- Producing sinter with lower sulfur content would improve blast furnace operation and reduce the amount of matte produced. Sulfur elimination is a key process step in sinter chemistry.

- Improving sinter machine operation would allow fugitive (hygiene) ventilation for the sinter machines to be improved. Improved ventilation would reduce the amount of lead-bearing residue entering the ambient atmosphere and covering the equipment, floors, and structures of the lead sinter plants.

D. Recommendations for Improved Performance

The Romplumb lead smelter has several operating and environmental problems. The most significant of these is poor quality sinter, which affects both lead production and pollution control. The low porosity of the sinter machine charge material is the major reason for poor quality sinter. One of the production and environmental problems caused by poor quality sinter is the generation of large quantities of matte. The EAPS team recommends concentrating on solving problems associated with low quality sinter through technical assistance and obtaining new equipment. The recommendations are described in the following sections.

D1. Romplumb Test Recycling of Matte on the Sinter Machines

Romplumb should conduct tests to improve the porosity of the sinter machine charge by adding a layer of coarse matte. The matte would be placed on the machine grates ahead of the normal charge materials. The matte is a common problem in both task 4, smelter operation practice evaluation and pollution control improvement and task 3, waste (matte) reduction and copper/lead recovery. Therefore, this recommendation is identical to recommendation 4.4.1, which can be referred to for a discussion on technical assistance and procurement, schedule and benefits, and overall responsibilities.

D2. Provide Technical Assistance to Romplumb to Improve Sinter Machine Operation

The technical assistance would give Romplumb information on U.S. sintering practices, technical literature and pricing for agglomerating (balling, briquetting, or pelletizing) equipment, an evaluation of Romplumb's drum humidifier as a balling drum, and technical information on chemicals for binding (binders) the sinter feed materials for balling or pelletizing.

Technical assistance and procurement. The technical assistance would include obtaining information on sinter feed preparation and sintering practices as follows:

- Pricing from companies that manufacture agglomerating machines and technical information regarding their experience in providing equipment for preparing lead sinter machine feed

- Technical information regarding binders for balling, briquetting, and pelletizing

- Economic information regarding cost of installations for Romplumb's capacity

- Technical information via document review and interviews with operating companies on past and current practices for lead sinter charge preparation

- Technical evaluation from companies that manufacture agglomerating machines on the use of Romplumb's drum humidifier as a balling drum to produce balls/pellets

There should be an opportunity for procurement of agglomerating equipment for Romplumb once the technical assistance is complete. The selected equipment could be considered for grant funding. IMNR is to investigate the availability in Romania of a used pelletizing disk.

Schedule and benefits. This recommendation falls into the category of a short-term action, which should be completed in two months including Romplumb's review. Once Romplumb endorses the technological approach to providing proper sinter machine feed material, installation of the necessary equipment becomes a long-term activity. The installation activity could take six to eight months depending on equipment delivery, modifications to the sinter machine feeding system, improvements in the hygiene (fugitive) ventilation system at the sinter machines, and sinter building modifications.

The economic benefits of an improved feed material are significant. First, the porosity of the sinter machine charge material would be increased, resulting in greater throughput for the sinter machine. Second, the improved porosity would result in more sulfur being oxidized to SO_2. The more sulfur oxidized, the less there is in the sinter. The lower the sulfur content of the sinter, the lower the amount of matte produced in the blast furnace. Third, with improved porosity, the sinter should be hard and abrasive. A hard sinter reduces the amount of recirculating fines and improves blast furnace throughput.

The environmental benefits of improved porosity are just as significant as the economic ones. First, the improved porosity will reduce the amount of SO_2 and dust entering the work area atmosphere. The hard sinter will reduce the amount of dust entering the pollution control system, reducing or eliminating overloading of the system. The backpressure from pollution control system overload should be eliminated. The higher quantity of sulfur oxidized will increase the SO_2 concentration in the sinter process off-gases and decrease the SO_2 concentration in the blast furnace off-gases. Concentrating the SO_2 in one process off-gas system will simplify an SO_2 scrubbing system.

Overall responsibility. EAPS will have overall responsibility for the technical assistance to gather, evaluate, and recommend the equipment and practices for improving the porosity of Romplumb's sinter machine feed material. EAPS and Romplumb will share responsibility for equipment purchase if grant funding is used for procurement. Romplumb or Romplumb and IMNR will be responsible for installation design and construction, while Romplumb will be responsible for operator training on the new equipment.

D3. Provide Technical Assistance to Romplumb on SO_2 Technologies

Romplumb's SO_2 in-stack emission exceeds the 1993 Romanian Regulation, Order No. 462, by a factor of approximately 10. Romplumb has requested EAPS to provide information on SO_2 scrubbing technologies.

Technical assistance and procurement. The technical assistance requires obtaining information on various SO_2 scrubbing and fixation (e.g., liquid SO_2) technologies, reviewing the technologies with Romplumb, and selecting the most appropriate technology for Romplumb's operations. This recommendation requires only technical assistance, so procurement is not required at this time. Once Romplumb's current operating problems are solved and the SO_2 distribution from the sinter machines and blast furnace is stabilized, there may be an opportunity for procurement, involving purchase of technology or SO_2 control equipment. Grant funding could be considered for the procurement at that time.

Schedule and benefits. The technical assistance is a short-term activity that, including review with Romplumb, could be accomplished in approximately two months. This activity is for collecting information, but Romplumb must eventually install SO_2 fixation equipment. Nevertheless, SO_2 fixation offers little or no economic benefit in a plant as small as Romplumb. On the other hand, the environmental benefit would be measurable. Reducing the current level of SO_2 emissions, which are approximately 10 times higher than the in-stack standard, would improve the ambient air quality in and near the smelter. Installation of scrubbing or fixation equipment would be a long-term activity and would probably begin more than one year from now.

Overall responsibility. EAPS will have overall responsibility for the technical assistance for investigating SO_2 scrubbing and fixation technologies. EAPS and Romplumb will share responsibility for selecting the technology for Romplumb. When Romplumb purchases the equipment, there may be an opportunity for grant funding. EAPS and Romplumb will share responsibility if grant funding is involved.

D4. Delay Improvements to the Blast Furnace Area

Poor sinter quality, with high sulfur content and soft physical characteristics, causes most of the operating problems with the blast furnace. Until the quality of the sinter improves, developing effective solutions to the blast furnace problems is not possible. A corrective action taken now could be totally negated by a change in sinter quality; therefore, this recommendation is to delay technical assistance in the blast furnace area.

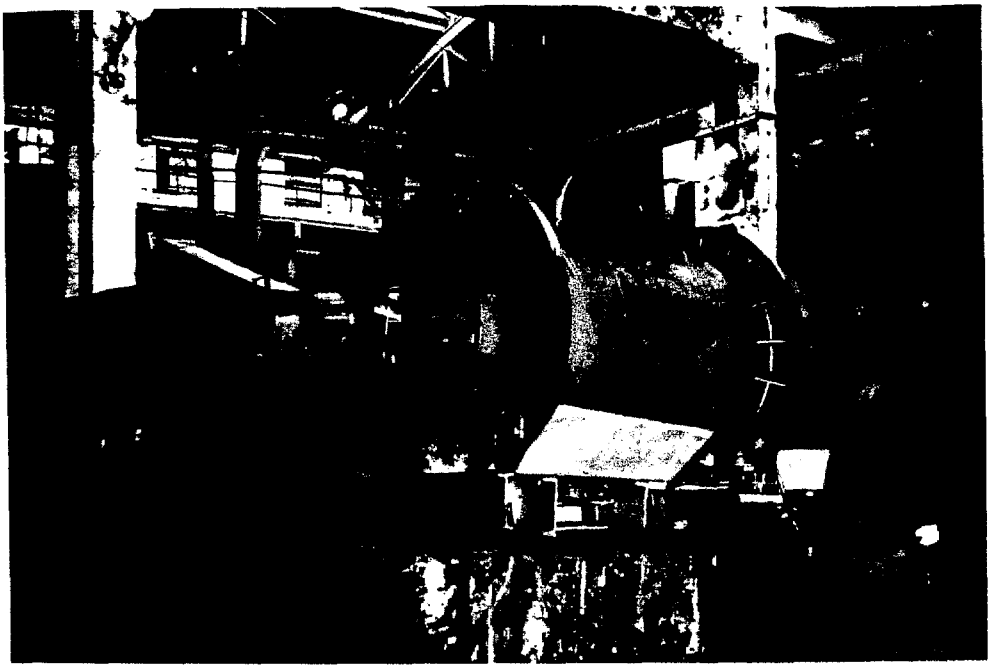
E. Scheduling of Future Activities

Activities can be initiated immediately on recommendations 5.4.1, 5.4.2, and 5.4.3. Contact should be made with Romplumb to determine the status of its efforts to test adding a coarse matte layer to its sinter machine. Once the EAPS technical assistance has completed the sinter and SO_2 information collection, a review meeting with Romplumb should be held. Romplumb's test results on matte additions to the sinter machine, and the EAPS information on sintering and SO_2 control can be reviewed at that meeting. An objective of such a meeting is to select the type of equipment for improving the sinter feed preparation and the SO_2 control technology.

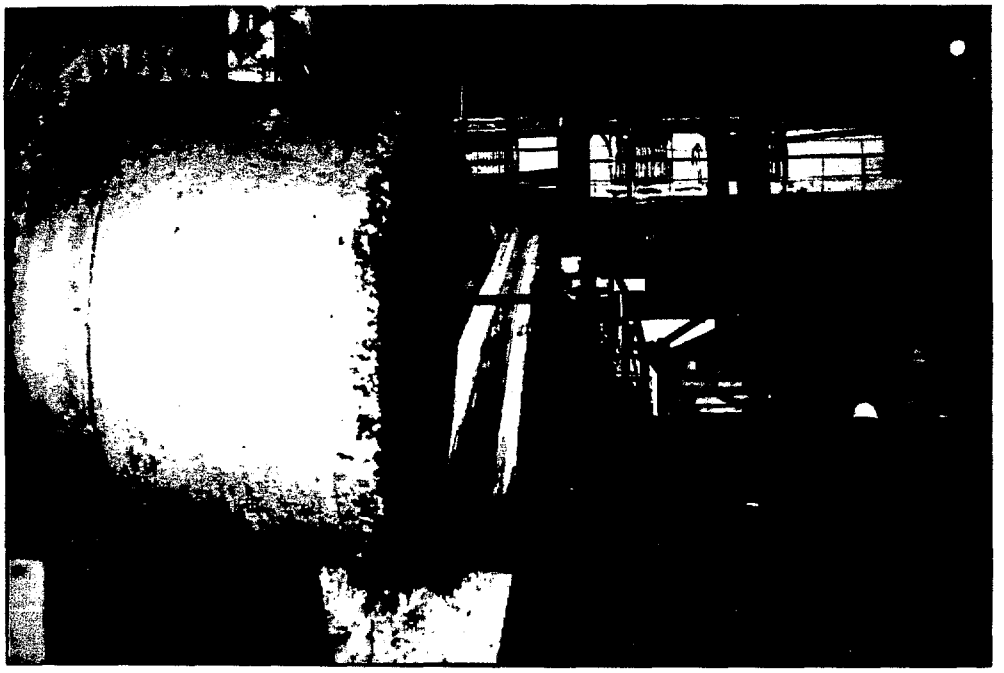
ANNEX A

ROMPLUMB SITE PHOTOGRAPHS

ANNEX A
ROMPLUMB SITE PHOTOGRAPHS



1 Drum Humidifier



2 Drum Humidifier Discharge to Conveyer

83

3 Sinter Machine

4 Wagonettes with Sinter

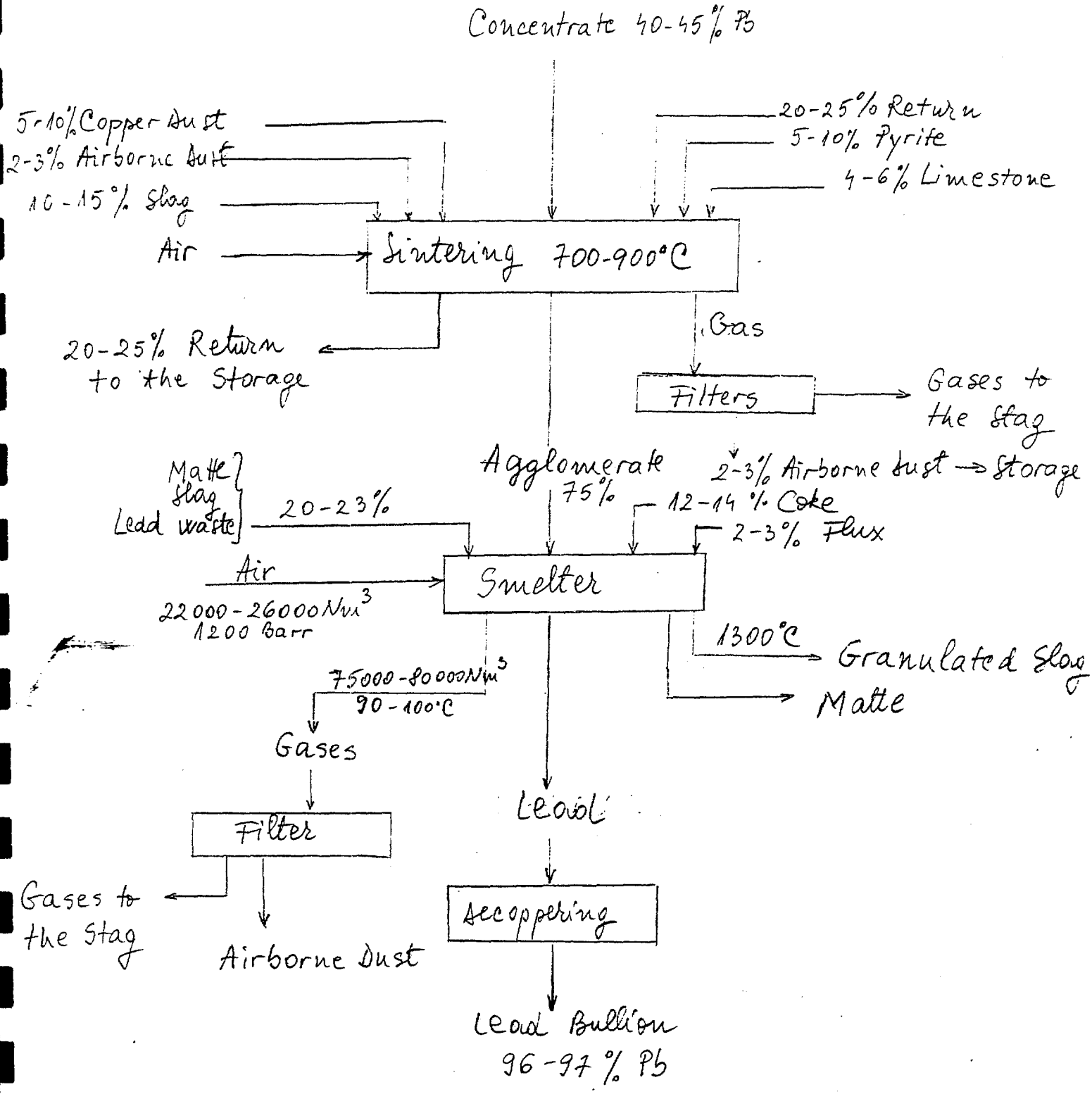
5 Blast (Water Jacket) Furnace Taphole

6 Blast Furnace Slag Granulation Pit

ANNEX B

PLANT FLOWSHEET AND SINTERING/SMELTING FLOWSHEET

Romplumb S.A.


Concentrate 40-45% Pb
5-10% Copper Dust
2-3% Airborne Dust
10-15% Slag
Air
Sintering 700-900°C
20-25% Return
5-10% Pyrite
4-6% Limestone
20-25% Return to the Storage
Gas
Filters
Gases to the Stag
Agglomerate 75%
2-3% Airborne Dust → Storage
Matte
Slag
Lead waste
20-23%
12-14% Coke
2-3% Flux
Air
22000-26000Nm³
1200 Barr
Smelter
1300°C
Granulated Slag
Matte
75000-80000Nm³
90-100°C
Gases
Filter
Gases to the Stag
Airborne Dust
Lead
Decoppering
Lead Bullion
96-97% Pb

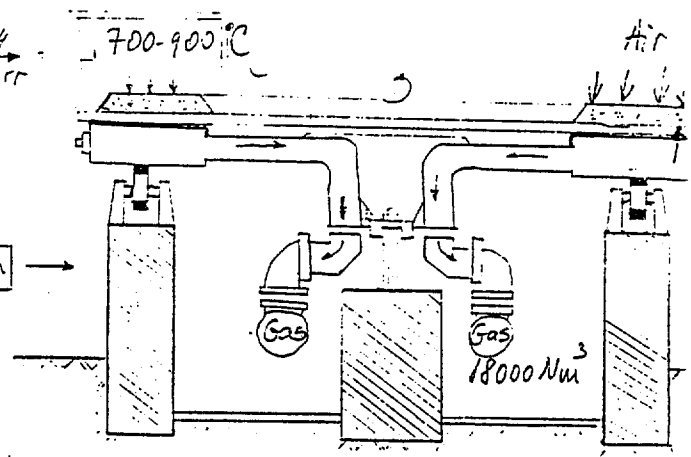
Roveplumb S.A.

Raw material, Auxiliary Mat

Mixture	Concentrate	40-45%
	Return	20-25%
	Copper dust	5-10%
	Pyrite	4-6%
	Limestone	4-6%
	Airborne dust	2-3%
240.	Slag	10-15%

%: S; SiO_2; CaO; FeO; Pb

→ Homogenization (6% H_2O) →



Storage

- The concentrate storage is subdimensioned
It is very difficult to deposite the concentrates, the subproducts and the fluxes on sortes and provenience
It is very difficult to realise the charge; we make it volumetrically. Sometimes we cannot assure the necesar amounts of recirculated subproducts (return, copper dust, etc)
- is not possible to respect the best Cu/S raport in the storage mixture because we don't have enough return and we can not desulphurate a part of the concentrate.

Sintering

- A very low productivity
- A partial desulphuration (50-55%)
- The air flow is insuficient for t
- The agglomerate does not have characteristics (a low mecanical re sulfur in exces, too much $PbSO_4$
- We can not assure a good perm the installation

...ols and Products / 24 h

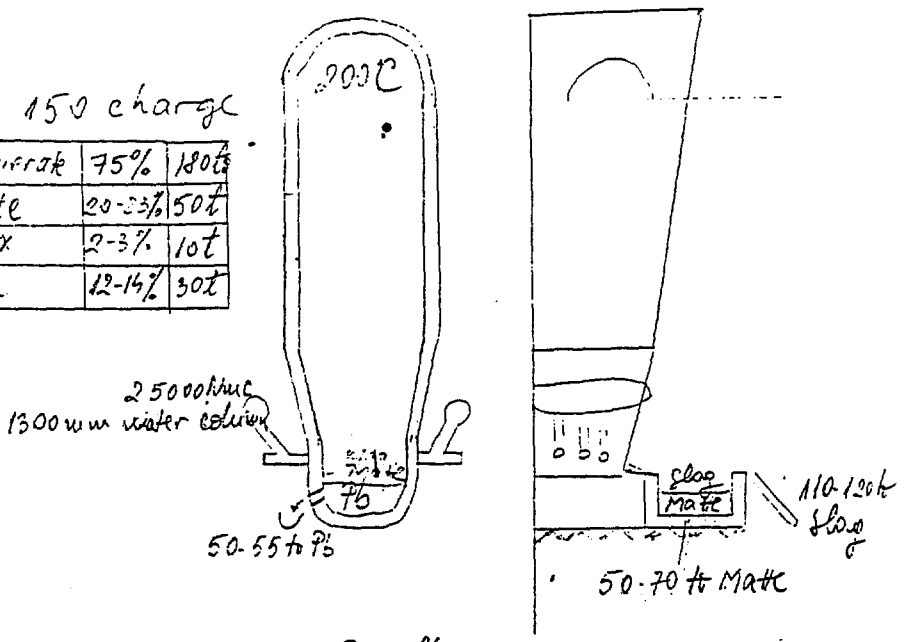
0-25 cm

⟹ 180 to agglomerate
52 to return ⟹
6-8 to dust

150 charge

Agglomerate	75%	180 t
Matte	20-23%	50 t
Flux	2-3%	10 t
Coke	12-14%	30 t

Gas 75000-85000 Nm³



developing of the process.

...e best fizico-mecanical
...stance, a low porosity,
...5-6%)...

...bility of the layout on

Smelter

- The W.J. charge is volumetricaly made
- We don't have the possibility to mecanize the prepair and the mixture of the agglomerate matte and slag introduced in the WJ furnance
- The charge rythm depends on the workers and on having the best amounts and dimensions for the materials we use.
- The sulphur exces drives to the obtaining of a matte which is very poor in Cu and very rich in Pb.

ANNEX C

TECHNICAL INFORMATION TRANSFERRED

ANNEX C
TECHNICAL INFORMATION TRANSFERRED

The following information was included in the packet given to S.C. Romplumb S.A. on July 3, 1996:

- Pollution Engineering, March 1996, Lead Battery Recycling 98%
- Table 2, Typical Lead Acid Battery Recycling Technologies
- The East Penn Process for Recycling Sulphuric Acid from Lead Acid Batteries
- Monsanto Enviro-Chem literature:
    - Air Pollution Control Technologies
    - Brink Mist Eliminators
    - The Pure and Simple Facts about Monsanto Mist Eliminators
    - DynaWave, Engineering Scrubbing Systems

Copy of materials for Romplumb given to IMNR on July 3, 1996:

- Table 2, Typical Lead Acid Battery Recycling Technologies
- The East Penn Process for Recycling Sulphuric Acid from Lead Acid Batteries
- Monsanto Enviro-Chem literature
    - Air Pollution Control Technologies
    - Brink Mist Eliminators
    - The Pure and Simple Facts about Monsanto Mist Eliminators
    - DynaWave, Engineering Scrubbing Systems