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ENVIRONMENTAL AUDIT

ISTROCHEM, BRATISLAVA

SLOVAKIA

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0 LETTER TO MANAGEMENT

Before we start to give our comments, we would first of all like to thank the management of Istrochem for their positive support. We would especially like to thank Mr. Tkac who did a great job as liaison officer.

0.1 Introduction

The chemical industry in europe is going through a difficult period.
Due to overcapacity in nearly all basic chemicals, and in particular in the plastics, industry prices have reached very low levels. Even polypropylene prices have tumbled to a level never seen in the past.
One of the reasons is the severe reduction in sales volume to East European and in particular to G.O.S countries. The Russian market has nearly disappeared and countries such as Czechoslovakia have seen their sales halved.

As usual all producers, including those in Eastern Europe, have tried to keep their sales up by increasing the export of additional volumes at dumping prices. The consequence being that the whole price level has dropped and margins are now being calculated on a basis of contribution to fixed costs.

This picture is not only true for the producers of basic materials. The same principle applies for the producers of finished goods. The only one who may benefit from this whole situation is the end-user or consumer.

In addition to these critical market conditions and small financial margins, the Slovak industry will face another problem i.e. the fact that Czechoslovakia will be split into two independent countries: Slovakia and Czechia.
Even if this separation passes very peacefully, from a marketing/industrial point of view nobody will enjoy/support this separation.

The consequence of all this will be that, in particular, large international companies will hold their plans and wait to see what is going to happen.
Such companies will have other potentially interesting plans and will therefor put investments in Slovakia lower on their list of priorities. These corporations will be very reluctant to invest in companies requiring large investments to bring production facilities up-to-date and to accept possible financial liabilities from environmental issues.

For the time being they may say that there are better opportunities to put your money into.

It is in this climate that Istrochem has to continue the process of privatisation which was started some years ago.

It is with these facts in mind and with practical experience from another large privatisation process in Poland that we accepted the invitation to join the privatisation team under the supervision of DRT Bratislava and prepare an environmental audit report.
The aim of this report is to advise the management of Istrochem about the overall environmental situation, including safety and health, paying particular attention to possible liabilities and remedial costs.

0.2 Our comments, restricted to main issues, read as follows.

0.2.1 Organisational structure and management performance.

We support the idea of organizing the company in business units headed by business unit managers. However we would like to stress that the business plan should include a paragraph on the effect of environmental, safety and health issues on present and future business and results. At this particular moment information is collected and stored in different places with different responsibilities. We strongly recommend that the business manager should be made fully responsible for the whole spectrum of environmental, safety and hygiene affairs. He may delegate and use the expertise of the various departments who take care of those activities but in the end he should be able to provide the environmental blueprint without reference to the responsibilities of other departments.

In the business plan detailed objectives should be mentioned in order to achieve better results in relation to safety and hygiene and bring environmental issues under control.

We noticed that Istrochem does have reliable knowledgable people. It is not a question of not having read the book. The point for Istrochem will be to get things done according to generally accepted standards and to have managers with experience not only in production, but also with basic understanding of finance and marketing.

One of the staff managers said:
Quote
When you ask attention for those things you fight like Don Quichotte. And I don't like to be a Don Quichotte
Unquote

During a visit to a certain department the gentleman in question asked our opinion about the introduction of an environmental management system. We advised negatively, but instead we advised investment in management systems.

FOR ISTROCHEM THE WORD IS CARE AND TRAINING.

We do understand that it will take time and that people have to learn.
50 years of a communist system did have its impact.

But progress should be made, and for new investors it is important to show that Istrochem is able to work with modern management systems.

We therefore strongly recommend to use the new SULFENAX plant as a model for implementing business unit management and operating the plant with environmental, safety and health standards comparable with those in Germany or Holland.
This may require extra management support from an experienced western manager leading to extra costs.
We strongly believe that the extra costs will be compensated by the decrease in various costs (e.g. waste from off. spec. production) and that the quality of the product will improve.
One may think towards achieving the ISO quality certification.

We also foresee that in order to implement this business unit management, certain activities should be centralised e.g. analyses in one laboratory.

The ultimate test could be to invite, say next year, a team to undertake an audit of the Sulfenax plant according to western standards. The results of such an audit will show Istrochem how successful they have been and to what extent they will be able to achieve western standards for the whole company.

Irrespective of what has been said before, the top management of Istrochem should start a simple programme geared to reach the people on the "workfloor" with the aim of improving environmental, safety and health standards on the entire site. The whole situation could be improved simply by proper initiatives from top management.
External funds may be available to cover costs.

0.2.2 Production facilities

It will not come as a surprise when we comment here that some production facilities are old and do not meet standards concerning emissions and generation of waste.
The production facilities which we would give a "go" or " no go " for further production and expansion, provided care is taken vis-a-vis certain environmental elements, are:

Fertilizer plant
In our view this plant has no long term future. A new plant should be built when commercial studies show that this kind of fertilizer has a future.The buildings may find some useful storage application for bulk materials.

Liquid fertilizer plant (FOSTIM)
Some investment say, $1 mln, would be required to repair the flooring and sewer system. Proper storage for raw materials should be constructed.

Plant protection chemicals

Aminex plant
MCPA is on the black list and we wonder about the future of this product. Major investment amounting to several million dollars would be required to give this plant a complete overhaul. The plant would most probably need a first stage (bio) waste water treatment plant to provide a waste water stream which can be accepted for further treatment in the chemical water treatment plant. The investment will be very high and one should think of say $ 3 to 5 mln.
The whole discussion becomes, however, rather irrelevant when this product has no future from a commercial/application point of view (black list).

Burex plant
Albeit revamped in 1989 it would require a clean-up maintenance. Not costly but it should be done. The waste water problem of this plant may be solved by installing waste water treatment equipment specially designed to improve the quality of the water to such extent that in future a central biotreater could reduce the organic content. PCA is also on the black list, it is important to invest of this product has a future.

Plant protection chemicals finalizing facilities
Very nice plant. No comments.

PP Fibres plant
Apart from minor investment to reduce smell, no real problems. The masterbatch plant is old and needs new equipment. More care should be taken to avoid spills from pigments and the waste collection should be organised better.

Specialty chemicals
Rubber additives (old plant)
The old "Sulfenax" should be closed. Cleaning of the site (soil, building) will be expensive as rubble and soil has to be considered as chemical waste. Costs could be substantial.

Rubber additives (new plant)
We advise investigating the soil in further detail and having a so called zero situation established. Extra investment in SO_2 absorption equipment of say $ 1.5/2 mln will be required to reduce the emission of SO_2 by 50 %. Due to international commitments the government will insist on this point.

Lube-oil additive
This plant does not operate properly. Several reasons are mentioned one of them being that the technology was not properly investigated. The future of this plant is therefore not certain. The plant would need at least to be cleaned and pending future processes the need for a plant connected water-treatment plant for pre-cleaning would be required. In this stage of the process we are not able to give any recommendations concerning investments to remedy environmental issues.

Viscose rayon
This plant is very old and management is claiming that this plant will be closed. Hygiene conditions are really bad. Closing this plant has already been a point of discussion since 1985.

We assume, however, that the plant will still be operating after 1993. We therefore recommend investment to improve working conditions for example overpressure hood at spinning wheels and provision and the use of inhalation masks. Attention should been paid by the management of the plant, that the employees, where those masks. Costs may be in the order of $ 1mln.

Bleaching clay
We feel sorry to say so but neither from a commercial, nor from an environmental point of view, do we see any future for this plant.

Explosives
From an environmental point of view we see no real problem. We recommend investment in new absorption equipment and storage facilities for acids. Some soil clean-up will be required. A cost estimate is difficult to give but could be around $ 1 mln.

0.3 Soil protection

Without any delay the programme to provide storage tanks with proper protection against soil pollution should be completed.

0.4 Soil/water contamination.

The soil at the site of Istrochem will be polluted, especially at old locations where DDT and other pesticides were produced. Analyses of samples taken when new buildings were planned give us reason to believe that the contamination varies all over the place.
Our main concern is whether the contamination reaches the groundwater level which is used for drinking water. The problem is known (Slovnaft).

In order to obtain information about water pollution we strongly recommend analysis of the problem in more detail and then taking proper action. In this phase we are not able to estimate costs.

0.5 Liabilities

In short we see that the company could be claimed liable for following issues:
- Health claims originating from the viscous rayon plant
- Pollution of the soil/ground water effecting the health of the people
- Future investors may be forced to accept clean-up costs

Some discussions with experienced lawyers would be required to control possible liabilities. The project does have an allowance for the kind of discussions required.

Another unwanted kind of liability could arise from pressure created by the local officials from Budmerice. In order to expand the waste dump permission is required from those officials. Already recently they insisted that Istrochem should build a pipeline for potable water at the cost of Kcs 20 bln.

0.6 Investments/remedial costs

Apart from the investments mentioned above additional investment would be required to improve specific situations such as:

Investment in $ US
figures to be read as indication only

Water supply to the plant.	0,5	mln
Central bio treater or improvement liquid and waste water streams at various plants	10/15	mln
Improving fire protection including (pipeline and equipment)	2/3	mln
Improvement of analytical department	1/2	mln
Optimization of waste dump at Budmerice	1/2	mln

Including the previously mentioned investments Istrochem should recoin with investment totalling an amount in the order of $ 25 mln of which only say a $ 5 mln will be required due to outspoken governmental pressure.
The liquid and waste water streams are still causing problems for which no technical solutions have been found through changing the process, and are the main reason for the large investment in one or some single plant-allocated bio water treatment plants.
Also yet not opportune Istrochem should anticipate that within some years the government will strengthen their action to improve water quality.

0.7 Government approach

The discussions we had showed that the government does realise that conflict exist between industry/employment and environment. They expressed their wish to remain on speaking terms with Istrochem provided Istrochem shows progress in controlling environmental pollution.

0.8 Future environmental policy.

Overall we do foresee a long term plan which would limit the activities of Istrochem to the production of chemicals and finished products which from a marketing, employment and environmental point of view show good prospects. Those activities may be the production of Rubber Chemicals, PP fibres, Explosives , Viscose Rayon and Liquid Fertilizers. A proper environmental policy should be developed and a budget allocated. The limited financial resources should be used to bring environmental problems of the before mentioned units under control and in line with government policies. The situation should be avoided where the limited money which is available is used for all kinds of different small projects and/or used for units which have no longer term future. In order to achieve those goals the management of the ecological, safety and health departments should be joined together, reinforced as far as management is concerned, and be under direct control of the managing director. The various business units should have an officer responsible for environment, safety and health who reports to the business manager but who also has immediate access to the central staff unit for environment, safety and health.

1 INTRODUCTION

1.1 General

Some time ago the government of Slovakia started a programme to privatize a large part of their local industry.

In the so called "first wave" initial steps were taken to create so called "joint stock enterprises" from the fully state-owned companies.

In the "second wave" the stocks held by the state will be offered to the public (35 %) and private investors. This means that pending the result of the privatisation to foreign investors and the public, the state may retain a certain interest in companies.

In order to evaluate the true value of the company, it is important that in addition to a financial and commercial evaluation, the company is audited from an environmental point of view, to obtain some indications of possible liabilities stemming from environmental issues such as pollution of soil or health risks. Future legislation for controlling and reducing pollution should also be known, especially when heavy investment would be required to comply with that legislation. Another problem could arise from possible bans on products. As a result of future legislation the productmix may change and therefore may have an effect on production facilities and sales turnover.

The way to obtain this information is to audit the company using a team of environmental specialists and prepare an environmental audit report.

The environmental audit was initially developed in the USA. In Europe, especially in the Netherlands, this audit is accepted as an instrument for developing an environmental care system because it provides the first essential information on the environmental background of a company.

The audit should prepare an inventory and when properly carried out should provide an environmental blueprint of the company.

In the case of Istrochem, TRN Environmental Consultants was asked to provide that environmental blueprint. For good order we mention here that TRN was not asked to promote and to help implement an environmental care system. We also consider this also as not opportune yet. Before Istrochem will considers investing in such an environmental care system, the organisation as a whole needs first to be reshaped into a company with modern management style and techniques.

Istrochem is now part of the second wave and consequently should prepare an environmental blueprint.

However, the technical/ maintenance level and environmental conscience of the company has suffered from the production push from the past. The Russian market which took some 50% of all products which were produced was not really interested in quality and did not create the conditions needed for the fine tuning of the production. The environmental auditor should not forget this and the technique of the audit should take this fact into account.

The audit should provide a blueprint and not a list of details describing what has to be improved to create a company complying with western technical and environmental standards.

Foreign investors should realise (and most times they do) that Slovakia is not a EEC country. However from the beginning onwards investors have the right to know which environmental issues could have a possible effect on strategies, level of investment and operating costs.

It is from this point of view that we started the audit and present the results.

1.2 Scope of the work

Keeping in mind what has been said in the introduction, a programme was developed consisting of interviews and visits to production sites and other relevant places. This programme was designed to give us a proper insight into the situation of the company vis-a-vis environmental issues.

1.3 Inventory

The inventory covered all the relevant environmental issues including safety, health and hygiene, which could effect present and future operations.
Any available facts showing the environmental history of the company are included.
Specific chapters are included on following subjects:

-Emission and immission levels
-Surface water pollution and functioning of the water treatment plant
-The use of ground/well/drinking water and contamination of sources.
-Soil pollution
-Waste disposal
-Storage facilities
-Fire brigade
-Safety, Hygiene Department
-Laboratories
-Health and Medical care (external)

West European legislation is used as reference point and where possible an estimate of remedial costs is given.

1.4 The report

The report largely follows the schedule as given in the scope of work. However the report includes a letter to management reviewing in short the main findings of the report and highlighting the problems which could have a serious effect on the company and showing the interrelationship with financial and commercial strategies.

In the last chapter we give a summary of the report including recommendations to improve the situation. In this chapter we provide some practical suggestions for obtaining a certain degree of improvement. A review of essential remedial costs is included in this chapter.

1.5 Standards

At this moment no generally accepted standards or certified methods are available for environmental audits, although some work on certification is in progress. We have studied these documents and we believe that our audit complies with present guidelines such as the one used by the EBRD (Economic Bank of Reconstruction and Development).

2 GENERAL INFORMATION

2.1 Full name and address of the company

Istrochem S.P.
Dimitrovova 34
83605 Bratislava
Czechoslovakia

2.2 Site map

For a plant layout see the general drawing of the Istrochem site d.d: september 1990.

2.3 Site location

The plant with all buildings etc. covers an area of 2 km^2.
On the site there are still some small lakes and it is possible to imagine how the area looked in the past.
The heart of the company is still formed by the explosives factory. The trees and bushes hide the location very well. Peacocks walking around on the explosives domain even reinforce the impression of walking in a garden. Generally speaking, during the time of the visit, the area showed a friendly clean and countryside look.
However the place is huge and the buildings are somewhat scattered around the site. Two main roads divide the area into three separate parts.
Some deserted buildings such as the one from the old DDT manufacture make you realize that the past must have been different. In particular the low level of production (a large part of the site was out of production or producing on a very low level) may have given a false impression. The truth most probably is that as a result of the dust from the fertilizer and bleaching clay plant, the smell from the pesticides, the danger of an explosion and the air pollution from many rather poisonous chemicals (H_2S, CS_2), this site normally presented a rather different picture.
From a health point of view, the site also raises serious questions.

2.4 Environmental pressure from surroundings

In earlier days the plant was far away from domestic life. At this moment, however, large flats are found adjacent to the factory. From this point of view the plant is badly located and one can imagine that some pressure has developed to minimize the present activities. There is, however, reasonable support from the local authority to continue the operations and people also accept the fact that Istrochem provides employment for many people.
No evidence was obtained of any pressure groups which could develop sufficient power to realize a drastic reduction of present activities.

2.5 Present management of the company

1. Managing and Statutory Director, Mr. V. Harminc
2. Director Manufacturing and Statutory Director, Mr. M. Orszag
3. Director Human Resources and Statutory Director, Mr. J. Gallo
4. Director Finance, Mr. A. Krutil
5. Director Strategic Planning, Development & Marketing, Mr. T. Kubecka
6. Commercial Director, Mr. A. Moncman

2.6 History of the company

1850 Marshland
In earlier days (1850) the present area where Istrochem is located was covered with lakes. It was really marshland comparable with the delta of large rivers.

1873 Founding of the company
Being such a desolate area Dynamit Nobel, the Swedish manufacturer of explosives selected this place in 1873 to start the production of explosives and ammunition. One of the customers being the Austro-Hungarian army.

At that time the site was selected as being at a safe distance from the town of Bratislava.

1951 Change of the name/change in products
As part of nationalization, the name of the company was changed into Chemicke Zovody Juraja Dimitrova in 1951. The production of ammunition was stopped and other products were brought into production.

1991 Change of the name of the company
In april 1991 the name was changed again into Istrochem.

Diversification.
Essential chemicals such as sulphuric acid, carbondisulphide etc. were being produced. The experience gained in handling this range of chemicals lead to diversification into the production of superphosphate, chlorosulphuric acid, bleaching clay etc.

Through amalgamation with other chemical producing companies (the government at that time liked the idea of giant companies) the company became involved in the production of agrochemicals, fibres and other products.

2.7 Present product range

The company which recently decided to reshape its organisation into business units produces at this moment the following products:

-	Viscose rayon	:	3,500
-	Sulfanax CBS/MG	:	10,000
-	Sulfanax CB/E	:	4,800
-	Fenadit M	:	2,500
-	Aminex PUR	:	3,500
-	Compound fertilizer	:	150,000
-	PP Fibers (BCF = Bulked Continuous Filament)		
	Virelon	:	10,000
	Barmag	:	700
-	PP Fibers (Staple)		
	V- 6.7 dtex	:	2,880
	K- 17 dtex	:	2,880
	PKH- 1.3 dtex	:	550
	Plantex 2	:	4,000
-	Liquid fertilizer	:	8,000
-	Industrial Explosives		
	Danubit	:	6,000
	Harmonit	:	1,800
	Polovit	:	1,800
-	Bleaching Clay	:	6,000

2.8 Application of the products

Explosives for civil applications

Solid/ granulated NPK fertilizers
N = Nitrogen
P = Phosphorus
K = KCl
for agricultural land

Liquid fertilizers for distribution to the "consumer " market.

Bleaching clay for food applications.

Plant Protection Chemicals for agricultural applications.

Polypropylene fibres for amongst other carpet production.

Specialist chemicals for the rubber industry and as additive for lubricants (oils)

Viscose rayon which is used in the textile industry.

2.9 Raw Materials

The main raw materials Istrochem uses are:

- Viscose Rayon
  - cellulose $C_6H_{10}O_5$
  - caustic soda $NaOH$
  - carbondisulfide CS_2
  - Sulphuric acid H_2SO_4
  - Zinc oxid ZnO
  - Ammonia solution NH_4OH
  - Natrium sulfide $Na_2S.9H_2O$
  - Acetic acid (vinegar acid) CH_3COOH
  - Lubricant oil

- Sulfenax
  - Aniline aminobenzene $C_6H_5NH_2$
  - carbondisulfide CS_2
  - Sulphur S
  - Cyclohexylamine $C_6H_{11}NH_2$
  - Natriumhypochlorite $NaClO$
  - Caustic soda $NaOH$
  - Oil

- Fenadit 11
  - Tetromere of Propylene
  - Phenol C_6H_5OH
  - Bleaching clay
  - Sulphur liquid S
  - Methanol CH_3OH
  - Calcium hydrate $Ca(OH)_2$
  - Petrosulphanat 30
  - Petrol - technical 80/100
  - Oil raffinate OR 935
  - Caustic soda liquid (100%) $NaOH$
  - Carbon dioxid liquid CO_2
  - Nitrogen liquid N_2

- Aminex PUR (Herbicide)
  - Ortho - Cresol $CH_3C_6H_4OH$
  - MCA (mono-chloride-acetic-acid) $CH_2ClCOOH$
  - Calcinated Soda NA_2CO_3
  - Natriumhypochlorite $NaClO$
  - Hydrochloric Acid HCl
  - DMA (dimethylamine) $(CH_3)_2NH$
  - Caustic soda $NaOH$

- Multi Component Fertilizer NPK 9-19-19
  - Ammoniumnitrate sollution NH_4NO_3
  - Tripple superphosphate
  - Monoammoniumphosphate $NH_4H_2PO_4$
  - Potassium Chloride KCl
  - Sulphuric Acid H_2SO_4

- Zeochem mineral AlSi
- Sulphite extract

- Polypropylene Fibers
  - PP chips
  - Color master batch
  - Lubrication

- Industrial explosives
  - Nitro esters $C_3H_5(ONO_2)_3$
    (nitro glycerine)
  - Nitro cellulose $C_{12}H_14(ONO_2)_6O_4$ to $C_{12}H_{17}(ONO_2)_3O_7$
  - Natrium nitrate $NaNO_3$
  - Ammoniumchloride NH_4Cl
  - Trinitrotoluene $[C_6H_3CH_3(NO_2)_3]$
  - Dinitrotoluene $[C_6H_3CH_3(NO_2)_2]$
  - Woodflour
  - Calcite
  - Carboxymethylcellulose
  - Colour
  - Salt NaCl
  - Zincumstearate $Zn(C_{18}H_{35})_2)_2$
  - Aluminium Al
  - Ammoniumnitrate NH_4NO_3
  - Oil

- Bleaching Clay
  - Raw Bentonite
  - Water
  - Hydrochloric acid HCl

2.10 Organisation

See appendix 22 for organisation chart

2.10.1 General

The organisation still shows the typical characteristics of a functional organisation, irrespective of the recently announced intention to change the company structure into business units. To change the organisation will be difficult. One should not forget that in the past companies like Istrochem were production orientated and, in such as environment, functional organisations did not function so badly at all looking at output figures. We agree and support the idea of introducing business units with corresponding management style long term but have doubts about doing it now on such a large scale.
We have the following reason for this view:
In the past it was essential that, to a certain extent, only the general manager was a general manager in the true sense of the word. With the present structure Istrochem requires managers at the top of each business unit and we wonder whether Istrochem is able to find the number of qualified managers required. If these managers do not understand the meaning of business management and from our own experience we are not positive they do, the company could easily disintegrate into small parts each struggling to survive. Although this may be less centrally controlled than in the past we feel that Istrochem should remain one company providing essential control and assistance on various operational matters and keeping a strong hold on the functioning of the company as a whole.
We suggest that only for those units where the chances for privatisation are promising, this business unit management is introduced and in the beginning only in addition to the present structure. Maybe Istrochem should seek assistance from experienced managers from elsewhere to achieve a proper understanding of the true meaning of business unit management.

2.10.2 Number of people employed

At this moment the company employs approx 4,500 people. This is about half of the number in the past.

2.10.3 Organisation of the environmental department

The department is divided into two sub units:
An analytical dept, which analyses the various air emission and waterstreams and other environmental analyses. In case the company does not have the equipment e.g. for soil analyses a laboratory of a specialised firm is used.
A registration dept where some people cover the paperwork required by the government. There is an expert for water, air, soil and waste.
It was a pity that we could not talk to this specialist. We would like to thank Mr.Spaniar for his help in showing us the information these colleagues normally provide.

3 OPERATIONAL SECTORS

3.1 Production of Fertilizers

3.1.1 General information

The fertilizer plants are part of the Business Unit Agro Chemicals.

The manager of the Business Unit is Mr. Ruzicka.

The plant manager we interviewed was Mr. M. Strapek.

The total number of people employed in the various units is 70.
On the map (see chapter 2.2) the plants carry following numbers 4450 - 4453 - 4420 - 4449 - 4448 - 3454 - 3450 - 4425 - 4427 - 4428 - 4429 - 4430.

The production of fertilizers consists of following units:

- production of compound/granulated fertilizers or so called NPK fertilizers
- production of triple superphosphate
- storage of solid materials
- storage of liquid materials
- production of liquid fertilizers.

3.1.2 Production of NPK fertilizers

N=Nitrogen
P=Phosphorus
K=Potassium

NPK fertilizers can be produced by mixing solid and or liquid raw materials.

Raw materials

The basic solid raw materials are:
- Monoammoniumphosphate
- Diamoniumphosphate
- Triplesuperphosphate
- Potassium chloride

The liquid raw materials are:
- Sulphuric acid
- Saturated Ammonium nitrate solution

The block flow diagram is given in appendix 15.

The production process can be described as follows:

The principle part of the unit is the granulator.
A granulator is a large (length 6 meters, diameter 3 meters) rotating drum. There are two granulators available. The solid materials are fed in one end of the drum and the liquids via a pipe which runs approximately to the middle of the drum. The pipe is fitted with nozzles to spray the liquid onto the granulates. At the opposite end of the drum the granulates leave the drum and fall onto the conveyer belt for transport to the dryer.

The granulator has two functions:
- mixing the compounds
- granulation of the blend

In the granulator triplesuperphosphate (solid) is mixed with potassium - chloride, sulphuric acid, saturated ammonium nitrate and a recycle-stream of product. The granulates are dried in a rotating drier. The drier is gas fired. The dried granulate is cooled down in a cooling section using air.
After cooling the granules are sieved to obtain the right sieve analysis.
The rejected fines (1-2 mm) are collected (10%) and returned into the system.
The course material is crushed again (50%) and also used again.
The product is sprayed with oil and coating with a clay to protect the product from caking.
After these manipulations, the product is stored in a bulkstorage-facility.
The product can by bagged in 50 kg PE bags or transported in bulk by road or rail.

Production-capacities:
240,000 tons/year, however the plant has been run at its limit of 300,000 tons/year. The last year the production was limited to 90,000 tons because of bad market conditions. The production is expected to improve in 1992 a little bit to 120,000 tons/year.

The production of triplesuperphosphate has been stopped because it is cheaper to buy the material on the open market.

Tankpark: The following materials are bought and stored in storage tanks above the ground in tankpits: phosphoric acid, ammonium nitrate, sulphuric acid, and coating oil. However as far as the oil is concerned they are using now a by-product from the cellulose-production.

Technical performance:
The technical condition of the plant is very bad. Improvements to create better conditions would mean building a new plant. There are no possibilities of revamping the plant because the structure of the building and the main machinery and apparatus would not ever allow an overhaul.
The plant was not in operation at the time of the audit. The stop was rather badly organized and one may have some doubts about the possibility of starting up the plant again.

The main issues of concern are:
- the construction of the building
- the rotating-equipment (special the dryer-drum)
- the wash and sewer system
- the water treatment facility

<u>Environmental factors.</u>

General:
For production and pollution figures see appendix 1.
The plant and the surrounding area is very polluted by waste fertilizer, raw materials and old machinery. Operating the plant according to acceptable (Western European) standards seems hardly possible.
The fact that people told us that the plant requires 6 hours maintenance daily may be proof of that.

Air:
The cyclones of the plant can't work properly because the cyclones were completely filled with product and consequently all dust produced during the process is emitted to the air. The dust-emission must be enormous.

The bad condition of the gaswasher and sewer system would result in a high emission of fluorine and ammonium chloride. Also the Nox emission would be very high. The Nox emission is the result of the reaction between sulphuric acid and the ammonium nitrate solution. There are no facilities to reduce the Nox emission. This problem could perhaps be solved if other raw materials such as ammonium sulphate and phosphoric acid are used instead of ammonium nitrate.

Soil Pollution:
One may assume that the soil under the buildings and in the surrounding area of the fertilizer plants will be polluted with components of raw materials and finished products. In the area of the storage-facility for coating-oil and ammonium nitrate the soil is polluted with oil. In other places soil-pollution by oil leaking and draining from equipment was also observed.

Water:
The water treatment section of the fertilizer plant also looks in very bad condition. The sludge collection unit and settling tanks were full with solid materials and can't be operated properly. It is likely that the waste-water is untreated.

Safety:
The condition of the plant is so bad that the safety of the workers cannot be guaranteed. The risk that the steel-construction of the building will collapse is not unthinkable. The quality, for example, of the iron grid floors and stairs are very bad. The operators of the plant must be exposed to very high levels of dust and probably also fluorine.

Risks:
The use of ammonium nitrate-solutions requires the necessary precautions. This is because there is a danger of decomposition, fire and explosion. The impression exists that in the design of the plant these issues were taken seriously. For example, there is no use of wood as construction material and we know from the literature that nitrated wood is extremely inflammable.The use of ammonium phosphates in production is also a sign in that direction as ammonium phosphates have a braking influence on decomposition.

The risks of working with Ammonium nitrate are not taken very seriously by the production personal. So there are no measures to prevent Ammonium nitrate coming onto contact with organic materials. An example is the situation by the tankstorage-facilities, where oil and Ammonium nitrate can easily come together. In view of the fact that there are examples in the literature of disasters which have occurred with ammonium nitrate such as Texas City in 1947 and Hacksawed in Germany in 1967, this is a very dangerous situation, not only for the risk of damaging the production site, but also the surrounding area.

Remedies:
There is only one solution for this plant and that is to close it.To do anything else would be money wasted. Building a new plant would be cheaper than revamping this one.

3.1.3 Triplesuperphosphate production

This plant is also old and in a bad condition, but if there are proper market solutions it may be possible to revamp this plant. The structure of the building, allowing for some backlog in maintenance, is in good condition.

The greatest problems in this plant are:
- dust emission of the millinghouse for phosphate
- emission of fluorine
  This pollution must be very high because the glass in the windows of the building ad the surrounding area were etched.
  It is also a important point for industrial hygiene because fluorine can seriously damage the health of the workers and the people who live in the neighbourhood of the plant.Problems with cattle are also possible, especially cows who are eating polluted grass. For this reason the whole gas wash section must be replaced by a highly efficiently operated gaswasher. The total amount of air pollution by fluorine has to be lower than as 1 kg/hr.

3.1.4 Storage of raw materials and products

The storagebuildings are reasonable except for a backlog in maintenance. An extensive clean-up operation is required for these buildings and the surrounding area. Perhaps there is a possibility of building a bulk-blendingfacility and buying the ingredients from others.

3.2 Production of Plant Protection Chemicals

3.2.1 General information

The department of Plant Protection Chemicals is part of the Business Unit Agro Chemicals.

The buildings are located on the map with following numbers: 4440 - 3425 - 3426 - 3427 -3501 - 3434 - 1441 - 1440 - 1433 - 1447 - 1416 - 1439 - 1419 - 1417 - 1418 - 1413 - 1407 - 1420 - 1465 - 1463.

The plants were not in operation. According to the management of the plant this was due to seasonal influences. However, the warehouses were very empty.

The total number of people employed at this plant is approx. 110/120.

The manager who was interviewed was called Mr Mrva. He was introduced as the development manager and an experienced scientist in the field of pesticides. The plants were mainly built under his supervision using Istrochem know-how.

3.2.2 History

Years ago Istrochem had already started the production of pesticides such as DDT and Methation. Methation especially was known for causing heavy water pollution. The production of DDT and Methation was stopped some years ago. However, even now, an old large deserted building was found on the site which had been used for the production of DDT. This building is unsuitable for any other purpose. Destruction of the remaining structure would be a problem as the rubble would need to be handled as chemical waste.

It will require a considerable area for storage of the rubble and the destruction of the building should be done under very controlled conditions, leading to extra costs. Further investigations should show how seriously the soil is polluted, and the need for soil to be removed at this particular spot in order to avoid further pollution of the area and to safeguard the quality of the groundwater.

3.2.3 Present situation

The present production of plant protection chemicals takes place at three different places.

-At the Aminex plant, MCPA is produced and blended.
-At another location Burex, containing chloridazone as active agent is produced.
-Near the Burex plant Istrochem has facilities to produce various blends.

The production is seasonable.

3.2.4 Production of Aminex

Production of MCPA based herbicides since 1983.
The block flow diagram is given in appendix 16.
MCPA is a herbicide based on the reaction of various chemicals.

The basic raw materials are:
-ortho cresol
-monochloracetic acid
-sodium hypochlorite
-sodium carbonate

At the moment about 2000 tons/year of pure MCPA is produced. The maximum capacity would be in the order of 3500 tons.

MCPA is reacted and blended with various chemicals leading to the following products:

Dikolen	: MCPA as such
Aminex pure	: Diethylamine salt (28% MCPA concentrate)
	: NH_4 salt of MCPA (22% MCPA)
Aniten I	: Aminex pure + Fluorenol + Dicamba
Aminex D	: Aminex pure + Dicamba
Aniten MF	: Aminex pure + Fluorenol

The total production including other active ingredients and fillers amounts to 7000/8000 tons.

Equipment/Maintenance
Glass, stainless steel and glass-lined equipment is used in this plant. Buildings and equipment are old and badly maintained. The way the glass lined equipment was fitted was not always very well done.
Storage tanks were kept in a tankfarm with a wall but the smell of ortho cresol was heavy even with the plant out of operation. The blending of the calcium carbonate with the o-cresol was very bad indeed. Cleaning of the reactor was simply done by dumping the water on the floor. The sewer system was badly damaged and the water undoubtedly pollutes the soil.
It was really a shock to learn that this plant was only 8 years old.

Safety
The plant did not show the level of safety it should have. The stairs were very bad and dangerous to use. The elevator so small that it could take only three people. There was no proper fire equipment.

Environment

General
For production and pollution figures see appendix 2.

Air
In principle there is no emission of a gaseous product in the process apart from some ventgas from HCL pumping during tank-manipulations. However in view of the technical status of the equipment one may expect considerable emissions of:
-Hydrochloric acid
-Ammonia
-Chlorine

Theoretical calculations taken from the process scheme give the following figures:

HCL	approx	200 kg/year
diethylamine	,,	20 kg/year

Soil contamination
There is undoubtedly severe pollution of the soil by all of the chemicals used in this plant.

Waste water
There are two water waste streams:
From the production of MCPA as such and from the production of the Aminex.
The waste water will contain as important pollutants:
o-cresol
sodiumchloride
MCPA
dimetylamine
The total quantity of waste water is 6 tons per ton of product.

Some years ago a project was started to investigate the possibility of building a biotreater. Istrochem had identified the problem of different chemicals and was thinking of two units:
- one for effluent containing organic chemicals
- one for inorganic chemical-containing water streams

However the situation has changed completely over the last few years and a new study would be required. Istrochem should, however, calculate for additional expense in view of the variety of products to be handled, and separate units per plant, could be considered.

Waste
A lot of empty drums were noticed which were being used to store waste chemicals. The solid waste is dumped at the dump in Budmerice. Information on quantities could not be given by the manager who was in charge. This gentleman in particular did not give us the impression that he was aware of the problems. Together with our observations at Budmerice we estimate that the total waste could well be in the order of 100 tons yearly.

Black list
MCPA is listed on the black list.

General conclusions/recommendations
We have serious doubts about this plant. Although the technology should enable production of these kinds of products with no severe technical problems, we found a plant which was badly maintained, unsafe and a danger for the people who work there.

We strongly recommend that extra attention should be paid to this plant and extra management control over the present plant personnel should be provided.

Conclusions/recommendations from an environmental point of view
The kind of chemicals which are used in this plant need extra attention from an environmental, safety and health point of view. We did not feel that this was properly understood. Continuation of the production with the present equipment and management could lead, in our opinion, to further environmental and health problems. The management of Istrochem should realize that claims could be filed in the future based on problems mentioned.
The remedial costs are difficult to estimate. However, we feel that it is more a problem of proper management rather than not having not the right equipment. A proper overhaul and good management could work miracles.
However,before taking drastic steps we recommend an investigating of the future of the product. Being on the black list it could well be that the lifetime of the product is limited.

3.2.5 Production of Anthrazine

According to the management, the production of anthrazine has definitely stopped. Because of this the waste water treatment plant functions better than in the past.

3.2.6 Production of Chloridazone

This production was completely revamped in 1989. The equipment therefore was reasonably complete.
According to the management the quality of this product is outstanding and meets equivalents from e.g. BASF (Piravin 430 Ft) and Oxon (Betoxen F 430).

PCA is produced from the following raw materials:
-furfural
-chlorine
-ammonia
-aniline
-sodium nitrite
-caustic soda
-sulphuric acid.
-sodium hydroxide
-sodium hydrosulphate
-phenol/cumene

The block flow diagram is given in appendix 3.

The pure product, with a purity of 90 %, is sold as such. The main part of the production of max. 800 tons/year is used for blending to make:
-Burex 80 (PCA + Surfactant) a powder which can be dissolved in water.
-Burex 430 DKW a suspension in water (43% active material).

The products being used are difficult to handle and demand proper attention. Chlorine arrives in railway tankers which are also used as storage containers. We could not visit the technical facilities because the plant manager had no keys!. According to his information there was a maintenance job going on and so the keys were in the hands of the maintenance people.
Instead we visited the storage site for ammonia where the same system is in use. The railway tanker is connected to the system and when empty is replaced by another one.
The storage of chlorine and ammonia is therefore limited to 40 m3 each. The storage for both products is within a concrete building.The building is equipped with a washer for emergency shutdowns.
However both buildings are quite near the fence of the explosives unit and will therefore be effected if there are serious problems in the explosives department.

Maintenance
Being revamped in 1989 it was reasonable that the technical situation looked satisfactory. However the whole maintenance scheme should be improved. The materials handled demand maintenance of the highest level. We noticed, for example, that the pipework in the ammonia storage facility was not properly fixed.

Environment

General
For production and pollution figures see appendix 3.

Emissions
During our visit the plant was not in operation so no physical observations could be made in relation to air. However, in view of the mechanical situation, we believe that emissions of the various chemicals will occur. We assume that the leakage of Cl_2 and NH_3 is under control.
According to information from the detailed process flowsheet, the following streams are ventilated to the air:
-trace amounts of $SO_2/CL_2/CO_2$
-substantial amounts of NH_3 and PCA (approx 500 tons/year)

Soil
The plant originates from 1965. We may therefore assume that over the years the soil has become polluted with the process chemicals which are known to be toxic (see also waste water).

Waste water
The water pollution is a problem. In order to control the PH large amounts of calcium hydroxide are being used. The water is toxic and no proper method is used to reduce the toxicity. The decontamination of the chlorine also creates a waterstream contaminated with sodium hypochlorite.
The volume of water used is large. For each ton of product PCA, about 65 tons of water are required. The waste water contains large amounts of calcium hydroxide and calcium chloride and impurities of the chemicals used.

Solid waste
Solid waste goes to the chemical waste dump in Budmerice. The plant manager was not really in the picture about the quantity of waste and did not feel responsible. The process waste containing, among others, phenylhydrazine, gives a theoretical value of 0,5 ton waste per ton of product. Including some allowance for inefficiency and other industrial waste we calculate the total waste going to Budmerice to be in the order of 1000 tons/year.

Black list
According our information PCA is on the black list. The management was not aware of this.

Safety and hygiene
The attention paid to safety and hygiene is insufficient to avoid accidents. A drastic improvement would be required.

General and environmental comments/recommendations
The process to produce Burex requires a cleaning and absorption process in which water is used. Without any further reconditioning this water is discharged to the water treatment plant creating substantial pollution.
Proof of this may be that according to figures provided by Istrochem, the water pollution expressed in C.O.D. amounts to 3336 kg/day.
We have no technical solution. We can only suggest the possibility of constructing a plant which is specially designed to control the waste water stream of the plant.
From a safety and health point of view we suggest an increase in the level of maintenance to avoid a situation the one like in the Aminex plant.

3.2.7 Plant protection chemicals finalizing facilities

A small very well maintained place. This plant showed, that with proper attention, people from Istrochem are, able to work according to good standards. The plant was equipped with various equipment for weighing, blending etc. The packaging line was not the latest in technology but, like, the rest of the plant, was well maintained. This unit also was not in operation.

Products which are produced here are:

Zeazine : blend of Anthrazine and other active material.

Maintenance
Good level

Environmental
No substantial comments. Some pollution may occur from leaking equipment.
According to information from Istrochem the waste water is somewhat polluted by atrazine.

Safety and hygiene
No comments

3.3 Production of industrial explosives

3.3.1 General information

The plant was built in 1873 by Dynamit Nobel, in the marshland far outside the city of Bratislava. Now the factory is on a factory-site and in the neighbourhood there are other factories and there are also people living in the area. Istrochem produces only industrial explosives and there is no production for military purposes.
The production taken place on a separate site within the Istrochem site. The site is very large. All production and storage facilities are very well separated from each other. The whole site is in a wooded, green landscape and gives a clean impression. The management and the workers who we met on the plant know what they are talking about. Some parts of the production were a little bit old-fashioned,but could be improved with some investment in modernisation. The acid plant and the acid storage, however are very old and should be replaced.

The production programme covers the following:
a. Production of plastic (jelly) explosives on the basis of nitroesters, with a total capacity of 7000 t/year.
b. Production of semi-plastic explosives with a total capacity of 2000 t/year.
c. Production of powder explosives with a total capacity of 2000 t/year.
d. Production of DAP type (ANFO) explosives.

Environmental issues:

General
For production and pollution figures see appendix 4.

Air
NOx emissions from the acid plant

Water
Some of the original marshland still exists on the site and the water looks polluted. We advise the taking of water samples for analysis.

Soil
The whole Istrochem site has a very serious soil pollution problem, The soil of the explosives site will also be polluted. New sources of pollution are the storage of sulphuric and nitric acid and the acid plant. When the storage tanks and the acid plant are replaced preventive precautions shout be taken. On the explosives site there is a fire place for burning waste. This should be cleaned up and the removal of waste should be properly organised.

Industrial Hygiene
Dust prevention measures should be taken at the production area for powder explosives. The Ammonia cooling unit is in a bad condition. Replacing this unit with cooling-unit which uses a less dangerous medium is desirable.
The storage and dosing unit for solid raw-materials is in a bad condition and the hygiene situation is precarious.

Safety (General)
The safety standards for the whole Istrochem site should be improved. The minimum safety standard on the explosives plant should also be raised. We think it is important to pay attention to these issues. Proper regulations, education, better and more personal safety equipment, more attention to good-housekeeping, more attention by the management ("it's a part of the job").

Security
At this moment it is possible that employees take explosives from the site, because there is no control system. This must be made impossible.

Risks
The main risks at this plant are explosions and the possibility of a chain-reaction. The lay-out of the plant makes the opportunity for a chain-reaction much lower. But there are some points needing of attention. The management told us that the government wants the plant closed because they are think that the risks are too great. The greatest calculated risk is an explosion of the largest storage facility. Our advise is to investigate those risks and draw risk circles on a map. When the risks are too high, it may be possible reduce the amount of stored explosives in the storage bunker. Another point requiring attention is the storage of ammonia and chlorine in the neighbourhood of the explosives plant.
The greatest risk, we think, is the transport by railway or road.
The railway goes straight through the city of Bratislava.
This must also be investigated.

Our advice is that if it is profitable to keep the explosives production running, there should be an internal and external safety-report which gives an description of the risks. With this document discussions with the authorities can also be started.

Fire-safety
The fire-fighting equipment is not properly maintained. The extinguishers must be protected against the weather, for example with a cover.
The fire-water supply of the whole Istrochem site is insufficient.
The greatest fire risk on the explosives plant is the risk of a forest fire. Fighting such a fire needs a great amount of water, so the plant needs an underground high pressure water pipeline system with hydrants on a distance of 50 - 100 meter.

3.4 Production of special chemicals Rubber and lube-oil additives

3.4.1 General information

For plant location : see map numbers 1455 - 1461 - 1467 - 1511 - 1512 - 1516 - 1513 - 1514 - 1517 - 1515 - 1518 - 1519 - 1520.

Plant personnel:
Business Unit Manager : Mr. Miroslav Orszag
Assistant Unit Manager : Mr. Lubomir Koleda
Plant Manager new lube oil unit: Mr. Stanislav Palenik
Plant Dev. Manager rubber chem : Mr Stefan Leska

Within the business unit the following products are handled:
-Rubber additives to control the degree of vulcanisation
-Additives for motor oils (lube oil additives) gear oils etc.

Both products have been produced for a long time (rubber since 1950 and lube oil since 1960).

The original plant which we could visit only for a short period was really very bad. We fully agree with the management of Istrochem that this plant should be closed at the earliest opportunity. One should allow for substantial costs for the cleaning of the site and the dumping the rubble from the buildings. A cost estimate is difficult to give but we believe that special protective clothing will be required for the job. We recommend that this job is done carefully. The place was covered with sulphur which starts fires easily.

The plan is to close the whole unit at the end of 1992 when the 2 new plants are functioning properly.

3.4.2 Production of lube-oil additives

Production in old factory
The production of lube oils in the original plant is based on the Zn salt of dialkyldithiophosphoric acid. The production amounted (1991) to appro 1700 tons.

The basic products are:
-Isobutanol
-2-Ethylhexanol
-P_2S_5

The production runs via isobutanol and 2-ethylhexanol condensation with P_2S_5, followed by a reaction with ZnO to produce the Zn salt.

-Blending with an oil gives a product called Multadit OB and OBD2
-Blending with other bought-in materials gives Kompadit MH, P731/DM

Maintenance
In view of shut-down maintenance is at a very low level.

Environmental
The present impact of this part of the production on the environment is substantial, indicated by the following figures:

Air : no serious emissions.
water : C.O.D of 1500 kg/day
waste : sludge plus some industrial waste , 500 tons/year chemical waste

However, according to the management there is certain pressure from the government for environmental reasons, and from the management itself for financial reasons, to shut down the plant. And it should be closed.

New factory
In view of the closure of the old plant we have concentrated our efforts on evaluating the new site.

About a year ago (in addition to the old existing plant) a new factory with a design capacity of 4000 tons/year was completed to produce lube-oil additives based on alkylphenolsulphate.

Alkylphenolsulphate is produced from the following basic chemicals:
Phenol
Propylenetetramer
Sulphur
Calcium hydroxide, sodium hydroxide and carbon dioxide.
Dieseloil
Bleaching clay
Methanol

The product is sold under the name of Fenadit 11.
The block flow diagram is given in appendix 19.
The plant was built under pressure from the former USSR. Under this pressure the plant design and construction was based on laboratory trials only. This together with incompetently trained operators, are the reasons that the start-up phase is still not finished. The product which is produced does not meet the specification.

This plant, which is basically only one year old, shows a very bad picture indeed.

The process generates H_2S which is being absorbed using NaOH under the formation of a 25% solution of Na_2S in water. However the waste waterstream could contain Na_2S and consequently when the PH drops below 7 formation of H_2S in the chemical sewer system can easily occur (and it happens). We obtained the impression that the Na_2S solution is not being sold but neutralized in separate tanks in the waste water treatment plant.

The plant was provided with modern computer equipment, but it seemed doubtful wether anyone was trained to use it.

Maintenance
We expressed our views before. Absolutely below acceptable levels.

<u>Environmental</u>

General
For production and pollution figures see appendix 5.

Air
There is a vent system with traces of H_2S from the NaOH scrubber. Nobody could show us the results of the analyses on the computer.
We could also not obtain proper information about the functioning of the carbonfilters. The smell was obvious even with this plant functioning on such a low throughput.

Soil
There should be no reason for soil pollutionat this plant. However, based on visual inspection, we would like to recommend to the plantmanager that better care should be taken in relation to spills.

Water
The process does not use water. Some water is used for cleaning which is collected and discharged via the chemical sewer system.

Waste
The process produces two types of waste:
A dispersion of caustic in a oilraffinate and a solid waste consisting of bleaching clay, phenol etc. The waste is burned using the incinerator of Slovnaft.
In total about 400/500 ton of waste will be collected when the plant runs at a capacity of approx 3,500 tons/year (0.12 ton waste/ton product).

General and environmental comments/ conclusions
The people we interviewed all admitted that the plant did not have much future, neither technically, nor commercially, nor environmentally.

3.4.3 Production of rubber additives

Rubber additives are produced in the so called "Sulfenax" plant

At this particular moment rubber additives are produced in a plant which was started in the early fifties. The capacity amounts to 5,600 tons per year. The basic product is Sulfenax. In addition other additives are sold such as 2 MBT, Pneumax DM, Hermath and some others. However Sulfenax is by far the largest volume sold. For producing the rubber additives a new factory consisting of two lines is under construction of which one line is nearly completed and in a start-up phase. The total investment for this rubber chemicals producing plant was estimated to be 1,7 billion Kcs.

For the production the following chemicals are essential:
^XDu,XKDC
CS_2
Sulphur
Cyclohexylamine

Description of the process.
Aniline, CS_2 and S are reacted in a reactor at a temperature of 300 C and a pressure of 100 bar. The intermediate is refined and the Ca salt is then converted with HCl into 2 MBT. Reaction with cyclohexylamine gives Sulfenax CB/E (old plant) or CBS/MG (new plan). The process gives off H_2S as a byproduct which in a so called Claus plant into liquid sulphur ready for re-use.
The plan is to shut the old plant down when the new plant comes on stream. Expected due date : end this year.

Plant lay out and other technical details of the new plant.

First of all we would like to mention that the management of the plant is optimistic about the start-up. We ventilated some concern about this optimism in view of the situation with the new lube-oil plant.

However is the plant lay-out, proper equipment such as spare pumps and the computerised control system have been incorporated which are useful assets. Facilities such as concrete floors and walls to contain spills were provided to protect the environment.

Environmental

General
For production and pollution figures see appendix 6.
Irrespective of the technical situation the process does have some points of concern from an environmental point of view.

Air
The Claus plant ventilates an air stream containing SO_2 and H_2S.
The amount will be in the order of 350 tons per year SO_2. In view of new legislation the government wants Istrochem to reduce this quantity by nearly 50%.
Extra investment would be required which, in our opinion, could easily be in the order of say $ 1 mln.
Another source of concern is the ventgas of the cyclohexylamine absorption tower.

Soil
We understood that the soil has been removed and that the plant should be considered as being built on clean soil.

Water
Production of sulfenax requires considerable consumption of water. Approx. 6 tons water per ton of product. The waste water stream contains high quantities of NaCl and carries organic material like cyclohexylamine. The water consumption in the old plant is even higher and amounts to nearly double that quantity.

Waste
There is an essential production of waste from the distillation of the water stream. The black pitch which appears as a deposit has to be dumped as chemical waste. According to the flow scheme the pitch production amounts to 0.313 tons/hour. On a yearly basis and running at full capacity of 10,000tons this would mean a waste stream of around 3000 tons/year.

General and environmental comments/recommendations
As said before we are less optimistic about the success of the start-up of the new plant. Albeit not part of our scope of work we would like to suggest the seeking of professional help from an experienced start-up crew and the application modern training techniques for the staff manning this new unit.

We would also suggest that once the first start-up troubles are over, this plant should be managed according present western standards and becomes the centre for further progressive management. The unit should become an example how plants are operated and maintained nowadays and how business unit management works. We suggest that new investments are financed now to cover further equipment needed to reduce the SO_2 emission.

3.5 Production of polypropylene fibres

3.5.1 General information

Istrochem is one of the largest producers of polypropylene fibres in Europe. The production includes staple and so called rayon fibres/ BCF fibres. BCF= Bulk Continuous Fibres.

The products from Istrochem are used in the non-woven and textile/carpet industry but also in insulation applications.

The buildings carry following numbers on the map: 0121/1 - 0122 - 0125 - 121/3 - 121/2 - 0123 - 0123/2 - 0123/1 - 0129 - 0130 - -126 - 0127 - 1631 - 1632 - 1636 - 1632 - 1637 - 1711.

We spoke to the following two managers:
The Business Unit Manager : Mr. Furman and his assistant Mr. Sloboda.
Both have backgrounds in manufacturing and have little experience in sales/marketing/finance.

In the past the unit produced large quantities for the former USSR.
Now mainly domestic markets are supplied and the production has dropped to a level of approx. 13.000 tons per year.

The plant employs 800 people and from an employment point of view this is high.

The raw materials come from Slovnaft. The price for PP mentioned was a little above DEM 1/kg. This figure shows how bad the situation in the market is. Even when, in the past, PP was some what in oversupply the level did not fall become below DEM 2,50. The low price for the raw material looks attractive. However it shows also that end-users have overcapacity. Margins on end products will also be small.

3.5.2 Production

The production takes place in three buildings:
- building 1 : PP1/2/4;operational but at low level.
- building 2 : PP3 ;mothballed (including the filtercigarette machine)
- building 3 : ;production of masterbatches

Some machinery has been renovated from a discontinuous into a continuous process. Machines such as the extruders were very old. The masterbatch factory in particular should be overhauled.

The production uses the following raw materials:

PP supplied by Slovnaft
Pigments
Lubricants such as stearates

The management assured us that no pigments containing heavy metals were being used anymore. We question the remark that in the past such pigments were also not used.

Safety
We noticed limited fire protection equipment in a plant which stores a lot of material which once it burns may result in fires.

Environment
For production and pollution figures see appendix 7.
The production of fibres from PP is in principle an environmentally-friendly process.
Attention should be paid to the following problems:
-smell from evaporating stearates
-soil pollution by pigments in the masterbatch factory
-control of solid waste coming from the fibre production and masterbatch factory

Especially the off.spec from drawing the yarn can be high. For BCF Virelon this can be 10%.

The solid waste can be recycled and used for less critical applications. Istrochem has a factory to do this. However we noticed quite some tonnage of off-specs and wonder about the possibility of re-using this material.

General and environmental comments/conclusions
There are in principle no reasons to consider the production of PP fibres as a danger for the environment. Provided care is taken of possible smell from evaporating lubricants (often stearate) this factory could continue to operate even in this residential area.

We have some concern about the situation in the masterbatch factory and would recommend a proper overhaul for this factory including the internal cooling system. Attention for spills of pigments, is also recommended.

The production should be checked for waste production and measures taken to ensure that the capacity of the recycling factory is sufficient to cope with the waste, together with proper marketing to sell the recycled material.

We recommend investment in proper fire resistant doors to contain fire in specific compartments.

3.6 Production of Bleaching Clay

3.6.1 General information

Plant numbers: 3409 - 3411 - 3412 - 3413.
Plant personal: 35
Production manager: Mr. Kelley
BUM manager: Mr. Novajek
The production of bleaching clay, was started in 1936 with a 3000 t/year capacity and now the capacity is generally the same. The ore volume is 5000 t/year and the ore used is called Bentanite. This ore is produced by mining, on the domestic market.

3.6.2 Production

The block flow diagram is given in appendix 20.

Process
The first step is washing the clay to separate sand and other materials from the clay. For this washing servicewater is used. There are no checks of the quality of this water available. The following step is the activation step. This step the slurry (clay in water) is brought together in a reactor with 31% hydrochloric acid. Here the metals are separated and changed for H+ ions on the clay. To increase the solubility of the metal salts and for mixing, open steam is injected into the reactor. This open steam also create the air pollution of the reactors, as hydrochloric acid fumes are emitted with the noncondensated steam. The next step in the process is filtration of the metal-salts and washing the clay to remove the hydrochloric acid sollution. This water goes via the chemical sewer system to the water treatment plant. The filtration cake is dried in a natural gas heated room-dryer. The following step is milling the clay in a free flowing material and than the clay is bagged.

Equipment/Maintenance
The whole factory is very old and badly maintained.
Some parts of the installation are not protected against the acid. For example the pump-propellers have to be changed every 24 hours. The reactors and storage-tanks are in such a bad condition that there are a lot of leakages.

<u>Environmental</u>

General
For production and pollution figures see appendix 8.

Air
HCl emission of the 4 reactors
NO_x emission of the roomdryer
Dust emission of the milling and bagging

The emission of HCl must be very high, also the dustemission.

Water
The waste water is polluted with hydrochloric acid and possibly heavy metals from the rock. The quality of the service water that is being used is not known.

Soil
The soil under the whole production-facility must be very polluted with hydrochloric acid and possibly heavy metals from the ore. The acid resistant floors are in a very bad condition.

Waste
During the production of clay there is acid sediment coming free. This sand goes to their own chemical waste dump.

Safety
The plant is very unsafe. Every where there is leakage of acid. The people do not wear protective clothing.

Health
The concentration of hydrochloric acid fumes in the reactorbuilding must be very high. These fumes are very damaging for the lungs.

General conclusion
From the point of view of environment, safety and health there is only one conclusion. This factory should be closed, as soon as possible.

3.7 Production of Viscose Rayon

3.7.1 General information

The Viscose Rayon production is part of the Business Unit Viscose Rayon.
The manager of the Business Unit is Mr. Záhradník.

The total number of employees in the Viscose Rayon plant is 800
On the map the plants carry following numbers 0100 - 0101 - 0102.

3.7.2 Production of Viscose Rayon

The production of Viscose Rayon is based on the reaction of the hydroxyl-groups of cellulose with carbon disulphide (CS_2) in the presence of sodium hydroxide to give xanthates which are soluble in water. The reaction can be reversed by acidification. Alkali cellulose is treated in rotating drums with carbon disulphide.
The product of this step is a viscous solution known as viscose, in which the cellulose molecule has been degraded to an average chain length of 400 to 500 C_6 units. Then the solution has to be ripened. The filaments from the spinneret are passed trough a bath of sodiumbisulphate and additives, where the hydrolysis is completed to give a regenerated cellulose fibre. After coagulation and twisting of the filaments into a thread, the product is washed and dried.

Formula:

$$(C_6H_{10}O_5)_x + xCS_2 + xNaOH = C_6H_9O_4 \cdot O \cdot C(=S)SNa_x + xH_2O$$

3.7.3 History

In 1953 Istrochem started production of Viscose Rayon. The problems in the past were high emissions of Carbon disulphide. Also on the workingplace the levels of Carbon disulphide and Hydrogensulphide were much too high, 30 and 40 times the Threshold Limit Value. Many (ex) employees of the viscose rayon plant have a working-related illness.

The effects of chronic poisoning, damage the central and peripheral nervous system and may be permanent if the damage has been severe. Sensory symptoms usually precede motor involvement. A secondary anamia may be caused.For this reason the Government of the Slovak Republic wishes to shut this plant down by the end of 1993.

3.7.4 Present situation

The plant was not in production at the time of our visit.
The maximum capacity of the plant is 6550 ton/year. The plant will produce 3400 ton in 1992. The product is not top quality but accepted on the market as useful.

Equipment/Maintenance
The plant is accomodated in a very large concrete building. The building has some backlog in maintenance. The equipment is very old and also suffers from a backlog in maintenance.

Safety
The main problem with this plant is the high level of Carbon disulphide in the air of the working space (see also appendix 12). The levels in the sulphidation and the spinning department are the highest. The concentration of Carbondisulphide is handmeasured. There are no continuous measurements. The problem with CS_2 is that the gas is almost odourless and heavier than air, so there is no warning of high levels of CS_2. The use of personal gas protection is not accepted by many of the employees.

Environmental

General
For production and pollution figures see appendix 9.

Air
Theoretical calculations taken from the process scheme give the following figures:

Production : 3500 ton/year

Carbondisulphide	CS_2	2904 kg/day	975,072 kg/year
Hydrogensulphide	H_2S	486 kg/day	163,232 kg/year

Soil contamination
There is undoubtedly severe pollution of the soil by Carbondisulphide and the other chemicals used in this plant.

Waste water
There are two waste water streams:
First the alkaline-stream, water with NaOH, Na_2S, Viscose, Sulphur, Lubricants, Sulphides, alkalinity up to 2 Gram NaOH/Litre.
Second the acid-stream, water with H_2SO_4, $ZnSO_4$, Non-soluble substances, acidity up to 2 Gram H_2SO_4/Litre.

Waste
The solid waste is taken to the dump in Budmerice.
The quantity is 300 - 400 ton/year.

General conclusions/recommendations
It is known that the Government of the Slovak Republic wishes to shut down the plant by the end of 1993. From discussions with the Business Unit Manager we understood that Viscose Rayon is a product with a good profit and maybe there is a possibility of using this plant as a cash-cow for financing other projects.
If this is true it may be important to postpone the shut down. In that case special attention should be directed towards the conditions of the air on the

workingplace.
The Threshold Limit Value of Carbondisulphide in Czechoslovakia is 6 times lower than in Western Europe, 10 mg/m3 against 60 mg/m3 in the Netherlands.
A further possibility is to build a system to dose fresh air into headcaps. This is a better system than using gasmasks. An other possibility is 2 hours work, 2 hours rest. A continuous alarmsystem for CS_2 is also necessary.
With a range of measurements it must be possible to continue production beyond 1993. The risks to the health of the employees must be held down to an acceptable level.
If this is a possibility then negotiations with the authorities could be opened based on better protection of the workers.

Conclusions/recommendations from an environmental point of view
The kind of chemicals which are used in this plant need, from an environmental, safety and health point of view, extra attention. We did not feel that this attention was a point on the agenda of the management of the Viscose rayon Plant at the present time.
Continuation of the production would only be acceptable when the risk of damage to the health of the employees is absolutely under control. In that situation it is possible to continue running this factory for a few more years.

4 ENVIRONMENTAL COMPARTMENTS

4.1 Emissions

The emission pattern of Istrochem is well known.

The emission is mostly of an inorganic nature if we consider CS_2 to be inorganic. Theoretical figures which we received show a total emission of all materials including dust of 1500 tons/year based on 1991 production figures.

We would suggest doubling this figure based on following assumptions:
- -losses due to pumping manipulations (storage) are not taken into account
- -the equipment is sometimes very old resulting in extra losses
- -careless behaviour of plant personnel
- -the extremely high losses of HCL in the bleaching clay plant which are not taken into account in the 1500 tons figure.
- -high losses due to dust in the fertilizer and bleaching clay plant

The main sources of the 3000 tons/year emission are :

CS_2 : from the viscose rayon and for a very small part also from the rubber chemicals plant: approx 1000 tons/year.
H_2S : from the viscose rayon, the rubber plant and various other places (claus, waste water etc): 200 tons/year.
SO_2 : mainly from the claus plant mainly: 200 tons/year.
HCL : mainly from the bleaching clay plant: 500 tons/year.
Dust: from the fertilizer and bleaching clay plant: 500 tons/year.
NO_x : The plant has no own boiler house. However at some places gas is burned for drying and some NO_x is emitted at the explosives plant. Quantities are not known but we estimate: approx 50 tons/year.

For air pollution figures see appendix 10.
The above figures are based on the assumption that the triple superphosphate and the sulphuric acid factory will not become operational agian.

It is clear that once the fertilizer factory and the bleaching clay plant are closed down two major sources of air pollution disappear. The whole situation will improve dramatically when the viscose rayon plant is also closed.

We would like to comment here that the emission of CS_2 does create a health problem. The average CS_2 concentration in the plant will be in the order of 80 mg/m3 which means that at some places the level is much higher. We consider an average of 80 to be on the very high side. The emission of 200 tons of H_2S should also worry the management.

Existing law
At this particular moment it is not clear what the situation actually is. In the present law 35/67 the chapter which controls the payment terms has never been completed. However, a new chapter is in preparation. This chapter will allow the authorities to negotiate specific conditions. Reference will be the T.A Luft ex Germany. Companies will receive sufficient time to improve their installations.
For NO_x and SO_2 these improvements must be implemented by the end of 1998.

The costs payable are based on the volume (and type) of emission, and the kind of product.

According to Istrochem the present payment for air pollution amounted to Kcs 295,090 in 1991 (emission in tons multiplied by Kcs 100). If this law becomes effective the costs will increase to nearly Kcs 6 mln.

The new law will force Istrochem to invest in equipment to reduce SO_2 at the sulfenax plant and NO_x at the explosives plant. Figures which the government may like to achieve in the longer term could be:
SO_2 40 mg/m^3
NO_x 70 mg/m^3

These figures are used for waste burners in Holland.
If this should be the case, difficulties are expected in meeting these levels.
At the moment Istrochem uses following limits:
SO_2 15 gr/m^3
NO_x 3 gr/m^3 at explosives and 230 mg/m^3 NPK plant.

The investment needed will be considerable and could well be in the order of $ 1.5/2 mln.

4.2 Water

Waste water
The whole waste water situation is of great concern to the management of Istrochem.
Even in 1992 a study was undertaken to investigate the possibility of a biological water treatment plant. However the situation is changing so rapidly that plans to built such a plant have been postponed.

The present waste water plant is a mechanical chemical waste water treatment plant. It is special in that when the pH of the incoming waterstream is too low, the water is collected in a separate basin, neutralised, and then fed to the main plant. A slide presentation of the plant is available.

The in and outgoing streams are analyzed. See appendix 11 for a review of such analysis.

In the letter of 2.8.1991 the authorities have given approval for Istrochem to discharge water under certain conditions. From the analytical dept. of Istrochem we also received a list with the analyses of the in and outgoing stream of the watertreatment plant based on analyses during 1992.

The figures are not above the limits. However, some figures are very high such as the C.O.D, sulphate, nitrate and chlorine concentrations. One may expect, and we were told already that these concentrations have to be reduced.

Some information which we received during the discussion with the authorities is given below.

Licenses	Present				Future
Concentration	max mg/l	max g/s	max kg/day	max ton/year	max mg/l
COD	1200	320	25505	9310	400
BOD	400	85	6425	2345	50
Non-soluble dry 105 °C	100	23	1890	690	
Non-soluble dry 500 °C	80	16	950	350	
Soluble dry 105 °C	5600	560	130370	47590	
Soluble dry 500 °C	4700	220	100945	36850	
$SO4^-$	2000	470	39620	14460	400
Cl^-	1450	350	30570	11160	200
ZN^{++}	5	0.8	63	23	
Non Polar	30	3.5	235	85	
Oil	200	30	2565	935	20
PH	4.5-8.9				6-8

The discharge volume is not changed and is equal to the figures on page 1 of the licence.
However we do question the fact that the government has limited the output of water. We can imagine that they want to reduce the pollution but this should be done as a total amount per chemical/pollutant. If Istrochem creates a situation where very pure water is discharged this would only improve the Danube water quality. Why should that lead to discussion and a penalty?

We suggest that this point should be discussed with the authorities as it hampers production with no advantage for the environment.

We suggest that in future agreements should be made per unit.

At present, the total wastewater stream should not exceed 11 mln. m^3 per year. From one of the papers we received we calculated a total actual wastewater stream of 20,000 m^3 per day which equals about 5/6 mln per year.This corresponds with the 50% output in product volume.
The discharge measured in C.O.D amounts to 18,000 kg/day.
This is equivalent to 100,000 inhabitant equivalents.
In other words : even with this reduced output Istrochem creates a pollution which is equivalent to the pollution from a town with 100,000 inhabitants.

To compare:
A fertilizer plant in Western Europe producing 3 mln. tons and equiped with a biotreater discharges the equivalent of 10,000 inhabitant equivalents.

The contributors to pollution are given below:

Product	Waste water volume	Pollution level (kg a day)			
	(m^3/day)	BOD	COD	Water Soluble	Water Insoluble
Viscose Rayon	4500	1918	4000	22400	200
Lub-oil			unknown		
Sulfanax CBS/MG	194		unknown		
Sulfanax CB/E			unknown		
Aminex PUR	266	607	1301	13680	86
Chloridazone	735	701	3336	13344	137
Comp. Fertilizer	77	5	10	4133	26
Bleaching clay	1867	33	132	10032	300
Liq. Fertilizer	1529	50	89	1999	926
Polypropylene Fib.	535	495	1000	651	103
Ind. Explosives	173	46	86	833	19
Sewage water	2244	286	440	658	440
Other users	2592	137	247	629	55

Closing the viscose rayon plant would really reduce the water pollution.

Given the above figures we suggest that before thinking in terms of a biotreater the future of the company must be known. If the viscose rayon plant is really closed by the end of next year, the biotreater will receive a different blend of waste water.

We also question the possibility of building a plant which can neutralize all streams and can cope with the fluctuating conditions. Also in the context of privatisation we recommend creating a situation where, the units become independent and control their own waste water streams.

Below is given a list with all payments concerning water for 1991:

For underground water	:	19,951	Kcs
For drinking water	:	4,968	Kcs
For public sewage	:	1,778,680	Kcs
For effluent ex water plant	:	10,667	Kcs

Sometimes penalties are given which can amount from Kcs. 20,000 to 200,000.

We were informed that new figures will be used to calculate the costs for discharging the effluent. The costs will increase sharply and an estimate of Kcs 7 mln. was calculated.

Drinking water is supplied by the waterworks in Bratislava. Industrial water comes from own sources (two different places). In respect of pollution of the groundwater (well water) the government sometimes uses the law which controls water to penalize firms who pollute the soil. There is basically no law about who controls the soil.

We would like to mention here that we were impressed by the number of analyses which are made. However it was also clear that the total picture was not available.

We came to the conclusion that it was well possible that the same analyses were made by the analytical dept. of the ecolab as well as by the central analytical lab. We advise a check on the list of analyses, and combination of the results.

4.3 Soil

At many places in this report we have already mentioned that there should be no doubt about the fact that the soil at Istrochem is polluted.

A site which has produced such a variety of chemicals over the years and knowing how waste was dumped in those days, (people told us that all lakes were used to dump waste) it is merely a question of knowing how serious the pollution really is, whether it affects the ground water, and what should be done to avoid possible effects on the quality of the water. We do not consider health as a matter of concern. We cannot imagine that this land will be used to build houses even in the future.

In order to obtain some information about possible effects we tried to obtain some information about production facilities in the past. We discovered that apart from the present building, pesticides like DDT have also been produced at other locations. We strongly advise an analysis of the groundwater including a check on chemicals which one could expect from all products once produced. The present analysis is an control system which is prescribed by the government. What we suggest is an analysis of the ground water for impurities such as DDT, MCPA, etc.

We suggest that a map should be drawn up showing the production sites of the past, and as investigation how to clean the soil around these places (which are affecting the water) should be carried out. Sanitation of the whole place is simply not possible.

In any case Istrochem should try to avoid further pollution. The action taken to improve the storage of chemicals is an example of the kind of improvement that Istrochem should carry out. We are, however, concerned that this mentality is not understood. We found still too many places e.g. leaking or non-functioning sewer systems where pollution of the soil was occurring.

If new installations are built we advise the production of a map which provides information about the initial situation in relation to the soil (zero situation), in order to have some reference point. We advised doing so for the new Sulfenax plant.

4.4 Waste

Below we give a list of wastes calculated from the mass balance sheets and according to the list we received from the Environmental Department.

List of wastes

Pollutant	Amount	
	ton/year figures from Production	ton/year figures from Env.department
Bleaching clay		
Coarse sand and ballast	312	100
Manipulation loses	60	
Sub. total	376	100
Viscose Rayon		
Contaminated textile waste		75
Wrapping material paper bags		26
Wrapping material after repairs		500
Acid waste		400
Sub. total	3841	1001
Sulfenax Old plant		
Sulfenax CBS/MG		
Sulfenax CB/E		
Fenadit 11		
Impurities from Zeazin production		21
Filtration cake from Sulka production		37
Filtration waste from Multadite		110
Filtration waste from Antioxidants		30
Distillation residues from processing off-gases from 2-MBT production		20
Distillation residues from production of Antioxidant 4K		10
Waste pitches from production of Sulfanax CB/E		950
Brickwork from Clauss ovens		200
Waste from drying rubber chemicals		90
Waste from cleaning		10
Rest after burning from production Lub-oil		560
Distillation residues from production Sulfanax CBS/MG	2254	

Pollutant	Amount ton/year figures from Production	Amount ton/year figures from Env.department
Waste resins from production Sulfanax CB/E	1075	
Bleaching clay from production Fenadit 11	173	
Sub. total	3502	2038
MCPA		
Unknown	-	-
Compound Fertilizers		
Impurities from phosphates	1800	
Contaminated fertilizer	2850	50
Phosphorus-gypsum sediments		1200
Sub. total	4650	1320
Triple Superphosphate		
Unknown	-	-
Liquid Fertilizer Fostim		
Unknown	-	-
Liquid Multicomponent fertilizer		
Sediments from production		120
Explosives		
Remnants from burning dumped as ash	77	60
Polypropylene fibres		
Discarded paper tubes		12
Discarded polypropylene cone-tubes		18
Polymer blocks	441	
Nudraron fibre	217	
Draron fibre	284	
Sub. total	942	30
Wastewatertreatmentplant		
Sludges		15000

Pollutant	Amount	
	ton/year figures from Production	ton/year figures from Env.department
General waste		
Defatting liquid Arva		2
Used emulsion liquid		3
Heat transfer medium		2
Wooden waste		80
Discarded wooden pallets		250
Wrapping after raw materials		
paper bags		130
paper bags with PE lining		70
Paper bags with sprayed PE		15
Corrugated paper boards		300
Impurities of raw-materials after cleaning storage halls		58
Contaminated earth from the Istrochem territory		5000
Total waste production of Istrochem	13384	25579
Total waste production excl. sludges from watertreatment		10579

These figures give us good reason to calculate a real chemical waste production of 12,500 tons plus waste from the water treatment plant of 15,000 tons. Including the waste from nearby small towns the Budmerice site receives about 30,000 tons of waste annually. One waste disposal pit is sufficient for three years.

The total costs amount to:	in Kcs	in $
Operational costs based on 25,000 tons	25 mln	900,000
Monitoring system (10 years depr.)	0.25 mln	8,000
Drinking water line (10 years depr.)	2 mln	70,000
Provision for first pit	2 mln	70,000 ?

Using above figures the cost per ton can be calculated. the cost amount to : 1170 Kcs (no interest cost).

During our visit to Budmerice we noticed that a lot of household waste was being be dumped here. We consider the dumping of normal waste as improper. We suggest negotiating different terms with the government and officials of Budmerice.The waste of Budmerice itself should be burned instead of being dumped at such an expensive site.

5 FIRE PREVENTION/REPRESSION/PREPARATION

5.1 General

The results of a fire at Istrochem could be very serious due to the presence of inflammable materials and the possibility of the release of toxic gases. There are certain provisions for prevention and repression of fire incidents available but the technical status is not very high.

5.2 Fire brigade

Istrochem has its own fire brigade at its disposal. The fire brigade exist of 68 people. In the morningshift 11 fireman and 3 First Aid. The continuous shift is working with a 3 shift system in a 24 hours service. An shift exist of 16/17 people They are all professionals.

Raising alarm for fire or accident is done by telephone. The fire brigade has its own telephone exchange, which is operation al 24 hours.

Advice about fire prevention measures is not part of the job of the fire brigade but is carried out by another department.

The garage of the fire brigade where the fire trucks and the equipment stands al time ready gave a reasonable impression. On one there is an immediately action necessary . However in the garage on one of the walls there is an heating radiator. Under this, at floorlevel, there is a valve without a handwheel. This pin could easily injure somebody).

The fire fighters follow a day-by-day scheme where training, sports and checking of the equipment are the most important issues are.

5.3 Remarks

Fire fighting system
The company has an separate system for fire fighting water which during the period when it is not being used for fire fighting is supplied by the cooling water system. During a fire the system is supplied by water from the river Danube via an 11 km long pipeline. Along this pipeline are pumping stations to boost the waterpressure. There is a double pipeline from the river Danube. Normal pressure in the system is 2.5 Bar en max. 5 Bar.
It was not possible to demonstrate the system. The system is in a very bad state of repair and probably should be replaced.

The delivery of fire fighting water takes place via 150 underground hydrants. The use of underground hydrants is discouraged because of the possibility of goods being placed in the vicinity of the hydrant making it inaccessible.

The water supply for fire fighting is extremely important. It is necessary to build a new pipe network with hydrants above the groundlevel and pump units. The distance between the hydrants should be no greater than 50 meters. The connection between the hydrants and the pipeline must have a diameter of 100 mm. In the intervening period it may be possible to connect the cooling water system and the fire-water system via an boosterpump. The fire-water system must repaired so that the system can operate without risk of leakage.
A pressure test is the best way to find out where the weak places in the system are.

Small fire-fighting equipment
On many places the small fire-fighting equipment was missing and was not available for immediate use. The inspection and preventive maintenance leaves much to be desired. Our advice is that the inspection system for the small fire-fighting equipment should be re-established.
The places where small fire-fighting equipment is needed should be re-considered in consultation with the management of the plant in question. Maybe it is good advice to set up, separate from the periodical inspection by the firebrigade, an internal inspection system inside the plants and, for example once a week, a member of the plantcrew could check all small fire-fighting equipment. In this way misuse and incorrect storage of small fire fighting equipment can be counteracted. Another positive point is that the personnel becomes familiar with the care of the equipment. After the inspection of the small firefigthing equipment, the equipment should be labelled to indicate when the last inspection took place. Date-stickers can be used.

An other very important item is the maintenance of powder-extinguishers located in an environment with vibrations, and that includes most places at Istrochem. It is necessary, once a year to suck the powder out of the extinguisher and to sieve it. After this the powder can be replaced in the extinguisher and is free flowing again. Otherwise the extinguisher will not function properly when needed.

Fire protection/prevention in plants
In the polypropylene plant there is insufficient attention given to fire protection measures to prevent the spread of fire. There are no fire compartments, so if a fire occurs it can spread over the whole factory. With certain measures it is possible to protect this plant against spread of fire because the building is of solid construction and made from concrete. So there is only a need for proper fire-doors to separate the different departments.

In the explosives plant there is a risk of a wood fire. To minimize that risk it is necessary for this area to have a good pipe network for fire-fighting water. There is also another problem as fire-fighting trucks cannot come into this area because the access-ways are too small. The burning of waste on their own fireplace must be stopped for environmental, but also for fire prevention reasons.

Emergency-sump for fire-fighting water
On a plant such as Istrochem is it is necessary to have a collecting system for water used for fire-fighting as the water can be contaminated with chemicals. Istrochem has a wastewater collecting system available, and at the waste water treatment plant there are basins which can used for this purpose. However, these basins were filled at the time of our visit. It is important to keep space available for this specific reason.

6 SAFETY, HEALTH AND INDUSTRIAL HYGIENE

6.1 Organization structure

The Safety and Health department is responsible for:
1. Safety of the working environment
2. Industrial hygiene
3. Fire prevention (advising)

Head of the Safety and Industrial Hygiene Department is
Mr. Rybnikár.
Head of the Industrial Hygiene Sub-Department is Mrs. Rybnikarova.

There are 16 employees working in the Safety and Industrial Hygiene department. The department itself is divided into a Safety and an Industrial Hygiene group, having 9 and 7 employees respectively.

There is no government influence on the organization of the department. Each company is free to organize a safety and hygiene department.
The only restrictions are that they must identify some employees (who is not important) responsible for safety and the company must have 1 employee taking care of fire prevention.

6.2 Injuries and accidents

Small injuries are written in a report book by the chief of the department where the employee works, but they are not reported further. There is no total overview for Istrochem of these small injuries.

If an accident causes illness fore more than 1 day, it is registered and reported. The report goes to the Trade Union Administration, Statistical Department, Safety Department and the Medical Department.

In the case of more serious harm to people, a committee must be formed to check the reason and the source of injury. They check the circumstances and the possibility of infringement of the law. The committee must come up with a proposal for the future. In cases where the employee was at fault, he does not get his full salary.
Members of the committee:
chief of the workgroup (foreman)
member of the safety department
trade union/Istrochem/inspector
-+ others if necessary

The level of safety-care by Istrochem is not very high.
The most important reasons for accidents are the so-called house, garden and kitchen accidents as stumbles, falls, slips, sprained ankles, specks of dirt in the eyes etc. It is possible to have positive influence on the number of accidents of this type by following good-housekeeping practices.
One of the first steps that is necessary is to clean-up the whole site and remove everything which is not useful. It is also necessary to pay attention to stairs and the iron grids. With this action is it possible to reduce the number of accidents by 30 a 40 %.

Another issue is the use of personal protection. It is absolutely essential that the operational personnel, especially the workers who can come into contact with chemicals, wear protective clothing. This clothing should remain on the site and not be taken home, there by reducing risks from possible chemical contamination.

Further more it is necessary for the employees on the site to wear safety-shoes. During our visit a lot of the employees were wearing open shoes (sandals) in places where they have to handle chemicals.

In calculating the risks which can occur from leakage of chemicals, we strongly advice implementing an order to wear eye-protection on thew hole site, especially in places where chemicals are stored and are in use. Extra emphasis should be placed on this because of the large amount of glass equipment in use in the production units.

Our last recommendation is the use of safety-helmets, especially when production units are shut-down for maintenance, as the risk of falling objects is then considerable.

6.3 Safety Performance

	1987	1988	1989	1990	1991
Number of employees	7445	7136	6562	6380	5373
Life casualties	5	1	0	1	0
Injuries	287	162	139	148	186
Lost hours	5778	5148	4308	5757	4241

6.4 Industrial Hygiene

There are several laws relating to hygiene in Czechoslovakia:
1. The General Act about health of people (1966)
2. Categories of working places (1986)
4. Hygiene limits for working places (1987)
5. Permit of the city of Bratislava based on the Acts above.

In accordance with this permit the Istrochem hygiene group analyses the air quality of the working environment every day, and reports to the hygiene station.
Places with a higher level of risk are divided into 4 categories:
1. Category no extra payments
2. Category no extra payments
3. Category extra payments for the employees 1.50 Kcs/hour
4. Category extra payments for the employees 3.00 Kcs/hour

Types of risks covered in the act:

- Chemicals
- Dust
- Noise
- Vibration

Places with a really bad working environment are:
Viscose rayon
Old Sulfanax
Bleaching clay
Fertilizers
MCPA

For registered concentrations see appendix 12.
For Threshold Limit Values see appendix 13.

6.5 Noise

The noise in many parts of the plants is at such a high level that it may cause deafness in the workers. The safe level is 80 dBA and at 85 dBA damage will occur. The workstations are well monitored and the figures are available. During our visits to the plants we did not see any workers wearing noise protection. In places with noise-levels above the 80 dBA protection is absolutely essential. In places with long shifts working periods it is necessary to bring the noise level down. This is necessary in the spinning departments of the viscose rayon and the PP fibers plant.
For noise levels see appendix 14.

6.6 Asbestos/PCBs

According to the management of Istrochem asbestos and PCB's are not used any more. Apart from old obsolete buildings the site is free of asbestos.
The PCB's are stored in a separate tank (waiting disposal).

6.7 Remarks of the auditors

At this moment the different departments report to different managers.
In view of the importance of Environment and Safety (including Fire care) it is our opinion that Safety, Environment and Fire should be brought together to form one staff department. Because it is necessary to have enough power and control in the management team it is important that the manager of this department certainly for the first couple of years,is a member of the management team.This construction should ensure that Safety and Environment receive enough attention from management
and that it is managed top down.

7 STORAGE FACILITIES/LABORATORY/MAINTENANCE DEPARTMENT

7.1 General

The storage facilities we visited during our visits to the plant all showed the same picture i.e. insufficient protection of the soil against spills and leakage of tanks.

The management is aware of this problem and estimates the remedial costs at about $ 1.5 mln but no action is planned.

The point, however, is that these tanks etc. will continue pollute the soil. We found, for example, a leaking HCL pipeline and an HCl spill where nobody was taking action to repair or clean the equipment (see picture).
These tanks etc. are all over the place which means that all over the site pollution of the soil is still taking place.
We recommend that the most serious problems are located and that proper action is taken.

In some cases we consider the situation very highly dangerous. This is the case with the tanks holding ammonium nitrate and the coating oil.

8 LIABILITIES

One of the reasons to include an environmental audit in a privatisation study is to discover liabilities stemming from environmental issues.

In this case we can identify the following liabilities:

8.1 From soil pollution

One can foresee a situation in the future, after the privatisation process has been successfully completed, when the new company will be found liable for pollution of the soil and forced to clean the soil or pay a certain penalty. Compared to the situation in, for example the Netherlands these cases are difficult to prove. In Holland the view taken is that companies cannot be found liable for pollution which took place before 1975. However, it is clear that at this moment pollution of the soil takes place. Therefore we believe that legal advice should be sought from experienced attorneys about the possibility of including a clause to provide potential investors with immunity from past pollution.
We therefore recommend that, for example in the case of the new sulfenax plant and the explosives plant (both candidates for a joint venture operation), steps are taken to show that pollution is under control and what the present pollution is.

8.2 From health problems

It is a well known fact that the levels of CS_2 at the viscous rayon plant were, and sometimes are still, dangerously high. It is also known that workers of this plant do have health problems. No complaints are heard, mainly because the work at this plant is better paid than other work. However it, is also known that people receive compensation in case of accidents at the factory provided the accident is not caused through negligence by the person in question. We do not see a difference between people getting a handicap or becoming ill from effects caused by their work.
CS2 is not only used at the viscous rayon plant. The old and the new sulfenax plants are also using CS_2. Another source of concern could be (but less so) the fact that the superphosphate factory, with the high immission of fluoride may, have caused some health problems. It is fairly unlikely but in the context of the above, this plant should not be re-started.
Our conclusion is that the privatisation process should only include those units which, from a health problem point of view, are worth continuing. Sanitation of the combination of plants is required anyway to improve the health conditions of workers and people living in the area.
One should not forget that international lending agencies such as EBRD only provide loans/subsidies etc to companies which will not have an adverse effect on the environment (Principle of sustainable development).

8.3 Claims from people living in the area of Budmerice

During our visit to the chemical dump site at Budmerice we were told that in order to obtain further permission for the expansion of the dump, the people living in the area had negotiated the construction of a pipeline for potable water. This request was granted at a cost of Kcs 20 milj.
Our recommendation is that a proper agreement is drawn up to show future investors under which conditions they may use the chemical dump.

9 DISCUSSIONS WITH GOVERNMENT ENVIRONMENTAL POLICY MAKERS

At the start (of the visit) we asked for a meeting with the local/governmental authorities in Bratislava. Finally, we were able to speak to the following people from the Slovak Commission for the Environment in Bratislava.

For emissions:
Mrs.(Ing.) Anna Violova (ex employee of Istrochem Environmental Dept.) and Director of Air Pollution Dept.

For water:
Mr.(Ing.) Milan Matuska, Head of Water Protection Dept.

The government issues the law, the local town authorities are responsible for executing the law. However, Istrochem is a very large company and is therefore more or less supervised by the government officials in Bratislava and not through the town officials.

The discussion with Mrs Violova was in principle an easy one. First of all she admitted having worked for Istrochem in the Environmental Dept. and she was very well aware of the problems. Her approach was realistic.
She said:
The Slovak Government has accepted certain commitments to reduce the air pollution caused by SO_2 and NO_x.
We would like to show that we have done something.
So Istrochem has to reduce its present levels by about 50 % for existing plants. The companies in question like Istrochem should show how they will reach such levels. Sufficient time will be given to invest in equipment. The deadline is 31 Dec 1998. New investments will have to be based on best technologies available to reduce the levels to an absolute minimum.

As far as other chemicals are concerned she realised that, for example the viscous rayon plant should be closed. On the other hand she also realised the economical impact. She confirmed that up till now the ecological lobby had insufficient power against economical considerations (to keep the economy going and unemployment down).

The discussion with Mr. Matuska had another character. He showed a letter in which the new payments were given for water pollution. However, he wanted to continue to in pose limits on the quantity of water which Istrochem was allowed to discharge. When we commented that this was not fair because putting a limit on water quantity would help nobody (imagine that this is pure water) the discussion ended somewhat chaotically. Nevertheless we achieved the agreement to re open the discussions and we suggest that this matter is discussed with the ministry.

P.S.
We understand that the government wants to achieve a reduction in pollution measured in kgs per year of a certain chemical. That should be the basis. It is irrelevant whether this quantity of chemical is dumped into the Danube with a little or a lot of water (by the way: the water flow of the danube is so high that the quantity of water is anyway irrelevant).

10 SUMMARY OF PRESENT AND POTENTIAL COSTS AND INVESTMENTS RELATED TO ENVIRONMENTAL ISSUES

Liquid fertilizer plants	flooring and sewer	$ 1 mln
Aminex	water treatment	$ 3/5 mln
Burex	water treatment	$ 3/5 mln
Old Sulfenax	demolition	$ 2 mln
Old DDT factory	demolition	$ 2 mln
New Sulfenax	SO_2 absorption	$ 2 mln
Viscose	better conditions	$ 1 mln
Tankfarming	soil protection	$ 1 mln
Watersupply		$ 0.5 mln
Fire protection		$ 1 mln
Analytical dept	new equipment	$ 1.5 mln
Waste dump	water protection	$ 1.5 mln
Explosives	NO_x reduction etc.	$ 2 mln

In addition to these costs, one has to calculate in the very near future for the following yearly expenditures for emissions, water and waste.

Emissions	Kcs 7 mln	$ 250,000
Water	Kcs 7 mln	$ 250,000
Waste	Kcs 7 mln	$ 250,000

11 CONCLUSIONS AND RECOMMENDATIONS

11.1 General

The audit should take into account that conditions in Slovakia are still very different from Western Europe

The style of the interviews and the conclusions should take into account that conditions and management in Slovakia are still very different from Western Europe/USA. The audit should therefore not provide a list of negative comments only. The report should provide useful advice too.

Generally we received proper support from Istrochem staff during our visit.

The management provided proper accommodation and tried to realize useful communications. We would like to express our appreciation for that.

Mr TKac was a great help like other managers.

We feel some disappointment about the fact that the Head of the Environmental Department did not participate somewhat more in our discussions. We discovered only at the end of our stay that once a year and for every unit an environmental blueprint is made. We have asked them to send us those documents to compare with our notes.

We saw nearly all of the production units. At least we saw the ones which are normally in operation. For obvious reasons the visit to the old Sulfenax plant was a very short one.

Location/ Environmental/Health and Safety profile is asking for serious attention.

The combination of products which are produced at Istrochem make it a plant with an environmental/safety and health profile which should be of great concern to everybody involved. At present the site of Istrochem is located in the near neighbourhood of a residential area. Further expansion with the kind of chemicals which are still produced at Istrochem would/could jeopardise the present status quo.

Access to the plant no real problem, but some attention would be wise to avoid serious accidents.

Roads and railways are available and reach the site. However one should calculate for restrictions covering the transport of explosives, chlorine, ammonia and other dangerous products through the nearby residential areas (if this is not already the case).

Istrochem is on speaking terms with government officials but should do its utmost to stay that way.

Apart from speaking to people of Istrochem we also had a meeting with officials from the Slovak government in Bratislava. Their approach was a fair balance between environmental improvement coupled with safeguarding employment. In view of international agreements the government will be strict on the severe reduction in emission of sulphur dioxide and nitrogen oxides.

The end of 31 December 1998 is the deadline for the industry to reach the goals which have been agreed.

We question the present way the government wants to control water pollution (restrictions on water volume discharge). We suggest that the management of Istrochem should discuss this question at the highest level within the government.

Istrochem is an industry which receives attention at government level.

Normally the local authorities should be the partners Istrochem should respond to for its environmental affairs. The governmental officials explained, however, that in view of the position of Istrochem the government itself will be in charge.

Political and market conditions for privatisation are difficult.

Newspapers and other magazines issue articles show a pessimistic view for the future of the chemical industry.
Polypropylene has never been as such a low price. AKZO informed the press recently of a further reduction of manpower in their viscose rayon plant in the Netherlands. Large corporations with policies to comply worldwide with optimum conditions for environment and safety for personnel will not be interested in investing in firms like Istrochem knowing that a large amount of money will be required to improve environmental/safety and health conditions.
We therefore see only possibilities to privatize certain parts of Istrochem and even that will be difficult.

Wait with final privatisation process until a proper market concept is ready and which should lead also to an improvement of the environment.

We consider it unwise to invest in the bleaching clay and fertilizer plants. To operate these plants according to appropriate environmentally sound principles new factories will have to be built . In connection with poor market conditions we see no future and advice closure at these two plants. We would like to advise that once the new Sulfenax plant is in operation the old plant should be closed without any delay.

Restricted introduction Business Unit Management and use new Sulfenax plant as centre for further training.

During our visit we noticed that most managers had only a manufacturing background. Their knowledge of finance, marketing etc. was limited. We suggest that business unit management is introduced in addition to the present functional organisation. In house training should produce the required numbers of managers pending what is left of Istrochem after reconditioning the company. The new Sulfenax plant, however, could be used a showpiece and training centre. With some help from experienced western managers the required level of experience could be achieved within a few years.

Reorganise the Environmental Safety and Health Department.

At this particular moment too many departments control a part of environmental/health and safety issues and information is fragmented. There should be one department collecting all information and able to show the environmental blue print of all producing units.

Plant manager should be responsible for all environmental, safety and health aspects of his plant.

Results and analyses of the plant operations should be incorporated in one data sheet together with environmental facts. The plant manager should be made responsible for all environmental/health safety aspects of the plant (and in the future the business unit manager) including costs.
The new Environmental Department could provide him with all information he needs to run his plant properly.

11.2 Comments in direct relation to production units

Plant protection chemicals
Environmental problems are severe but could be kept under control. Our main concern is the environmental future of the product itself in view of the fact that PCBA and Burex appear on the so called black list.

PP fibres
No real environmental problems. The masterbatch plant should be overhauled and attention should be paid to proper operational environmental care.

Viscose rayon
We do not believe that the plant will be closed irrespective of the fact that from a health point of view the plant should be shut down. We therefore recommend that the plant personnel is provided with the best inhalation equipment available, that plant managers control the use of it, and that technical adjustments are made to reduce the health impact to a minimum.

Fertilizers
This plant does not meet environmental standards at all. To improve the situation a considerable investment would be required. In principle a new plant is needed. Including the bad market conditions we suggest closing this plant.

Specialty chemicals
We agree with the plans to close the old Sulfenax plant. In order to do so it is essential to have a successful start up of the new plant. We strongly recommend consideration of the provision of additional assistance to the present start-up team. In view of what happened with the new lube-oil plant we are not so certain that Istrochem has the professional plant personnel available to start this plant. Environmentally it is a difficult plant in view of the chemicals which are used. Additional investment in the order of $ 2/3 mln will be required to cope with extra claims from the government to reduce the SO2 emission and to reduce the waste problem. It is well possible that in the somewhat longer term a waste water treatment plant should be built which is able to control the waste water stream. The money involved is difficult to estimate but a few million dollars at least would be required.

Explosives
With this plant one should calculate for additional investment of $ 2/3 mln to revamp the NOx absorber unit and revamp the loading facilities.

Bleaching clay
Our comments are simple. This plant has no future.

11.3 Environmental compartments

Emissions
Closing the fertilizer, old sulfenax and bleaching clay plant and reducing SO2 and NOx emissions according to new governmental regulations would already decrease the total emission of chemicals drastically. We suggest that after those actions have taken place and when financial conditions have been improved further steps are taken to minimize air pollution.

Drinking and industrial water
The use should be monitored and reduced.
The transport pipelines are leaking and plant personnel is very careless with the use of water. Remedial and educational action should be taken. This will have an immediate positive effect on the cashflow.

Groundwater
Analyze the groundwater quality more frequently and take remedial action when the quality deteriorates.

So far the deep ground water which is used for technical applications does not give reasons for great concern. However, we recommend monitoring quite frequently the upper groundwater levels in small lakes and downhill to the Danube. Pending the results a further programme should be started to bring further pollution of the deep groundwater under control. Compare Slovnaft and the dramatic consequences of pollution with oil. Costs would not be so large as the analyses could be done by company personnel. An experienced company should select the places for borings and equip these borings with permanent sample equipment. Costs: $ 0.5 mln ?. The chemicals which should be analyzed should include chemicals produced by Istrochem in the past such as DDT.

Waste water
No plans concerning a biotreater should be started before knowing what the future of Istrochem will be.

In our view some plants now contributing to substantial waste water production will be closed in the very near future. We suggest having first a proper plan about the future before investing in a biotreater.
We foresee a future where plants will be very independent and may prefer to have their own complete water treatment plant leaving maybe an effluent which requires only a relatively simple mechanical/chemical treatment. The cost of the biotreater may be divided into smaller proportions across the plants which require such biotreatment.

Soil
Monitor soil quality and sanitate those areas which may effect the groundwater.

The total area of the land at Istrochem may be considered as polluted. Cleaning the whole site will be impractical. Only those pieces of land where products like pesticides are dumped and those which show up as dangerous for the water quality should be sanitated.
The costs could be acceptable in view of the fact that Istrochem has the possibility of dumping the soil at Budmerice.

In the context of preventing further pollution we strongly recommend the following actions:
-Avoid further pollution from careless behaviour
-Finish the present investment programme to provide storage tanks with protecting flooring and walls.

Waste
The chemical waste dump at Budmerice requires better technology and equipment.

A proper agreement should be made with the authorities to avoid unrealistic financial compensations for future use.

Extra investment is required to control the waterpollution.
We recommend also the selection of proper lining material which is not always the cheapest. One should not experiment with new technologies. The costs could well be in the order of $1/2 mln to improve the whole situation and bring water pollution under control.

11.4 Liabilities

Together with an experienced attorney the consequences of liabilities as a result of health effects and soil pollution should be considered.

The possibility exists that in future when problems arise (for example with the water quality) that the government starts to hold the company liable. The same can happen when ex-employees realize that it may be possible to sue the company for health problems. The viscose rayon is known to effect the health of people. Future investors should be able to discuss those problems and reach an agreement for future liability costs.

A sum of $ 20/25 mln is essentially required to update Istrochem from an environmental point of view.

A new department integrating all environmental and safety and health aspects is required and should be headed by a very senior, experienced manager who is part of the management team.
A review of all costs to remedy environmental problems now and in the future gives a figure which is in the order of $20/25 mln. This is a large amount. Also from a political point of view Istrochem is facing a serious situation.

Albeit Istrochem is on speaking terms with the government now, it should remain that way. One may expect that as time passes the people living near Istrochem will also come with claims to reduce emission and noise.

The whole situation demands a reorganisation and amalgamation of the Environmental Safety and Health Department. One should have a manager able to manage this department. He/she should be part of the management team.

Each unit should have an environmental, safety and health officer who reports to the plant/business unit manager. This officer should have access to all information collected by the central eco.dept.

At this moment nobody really cares. Responsibilities are fragmented. We strongly recommend integration of the function of "eco officer" in the line (unit) management. The central "eco dept" can provide advice, information etc., but the eco officer is responsible for ensuring that things are being done and kept under control. Eco information and plant operation info management should be integrated.

Compound Fertilizers

Production of NPK 9-19-19 : 150,000 ton/year

Input: in ton/ton product

Raw materials	Input	Output Product	Output to Air	Output waste water	Output Solid waste
Ammonium nitrate (in ton of N)	0.07862				
Triple Superphosphate (in ton of P_2O_5)	0.12529				
Monoammoniumphosphate	0.12860				
Potassium chloride (in ton of K_2O)	0.21281				
Sulphuric acid (in ton of monhydrate)	0.11455				
Zeochem-mineral AlSi	0.008				
Sulfite extract	0.008				

Output

Product: Compound Fertilizer 1.000

Gaseous waste

. off-gases from the granulator :	0.235 gr NOx/ton product ??? 234 mg NOx/m^3 Air (Mr.Strapec) 60 ton year (Mades report)
. solid emissions from fluid cooler (dust) :	0.323 gr Dust ton product ??? 56.4 ton year Dust(Mades report)
. off-gases NH_4Cl :	No figures available
. off-gases F :	No figures available
. off-gases NH_3 :	2 mg/m3 - 0.3 ton year

Liquid waste

Total amount:	0.1	m^3/ton product	15000 m^3/year
Composition:	N: 410	gr/ton product	61.5 ton/year
	P: 710	gr/ton product	106.5 ton/year

Solid waste

. Raw materials manipulation loses	0.012 ton/ton product	1800 ton/year
. Expedition losses	0.019 ton/ton product	2850 ton/year
Total		4650 ton/year

The losses of solid waste are 3.1% of the production.

Aminex PUR

Production of Aminex PUR (28% of technical MCPA) : 2000 ton/year

Input: in ton/ton product

Raw materials	Input	Output Product	Output to Air	Output waste water	Output Solid waste
Ortho Cresol	0.226				
MCA (monochlorineacetic acid)	0.229				
Calcinated soda Na2CO3	0.153				
Hypochlorite	2.000				
HCl 100%	0.210				
DMA (dimethylamine) 100%	0.076				
NaOH 100%	0.200				
Total input	3.094				

Output: product (28% of technical MCPA) 1.000

Composition of MCPA:

2-methyl- 6 -chlorine-phenoxyacetic acid	83 - 85 %
2-methyl-4.6-chlorine-phenoxyacetic acid	0 - 7 %
2-methyl-phenoxyacetic acid	0.5 - 1 %
2-methyl-4 chlorphenol	0.6 - 0.7 %
NaCl	3 - 5 %

Gaseous waste No figures available

Liquid waste

- waste water from filtration and neutralization of MCPA, containing Ortho-cresol, Phenoxacetic acid, Na salt, NaCL, MCPA. : 5.6497 ton/ton MCPA; 11299.40 ton/year
- waste water from DMA absorption, containing dimethylamine : 0.3624 ton/ton MCPA; 724 ton/year

Solid waste : No figures available

Chloridazone
(burex 80)

Production of Chloridazone : 800 ton/year

Input: in ton/ton product

Raw materials	Input	Output Product	Output to Air	Output waste water	Output Solid waste
Fural	0.740				
Chlorine (liquid)	2.235				
Ammonia	0.600				
Sulfite extract	0.109				
$Ca(OH)_2$	0.769				
Ammonia water	0.260				
Aniline	0.570				
$NaNO_2$	0.540				
Na bisulfite	1.410				
NaOH, liquid	0.780				
HCl	1.465				
Phenol, cumene	0.160				
H_2SO_4	0.222				

Output

Product: Chloradizone		1.0000			
Gaseous waste					
. off-gas from prod. of FH.HCl, containing trace amounts of SO_2			not measurable		
. off-gas from prod. KMC, containing CO_2 and trace Cl_2 (below 2 mg/m^3)			0.0838		
. off-gas from drying of Chloridazone, containing ammonia, Chloridazone			0.590		

	Input	Output Product	Output to Air	Output waste water	Output Solid waste
<u>Liquid waste</u>					
. Waste water from crystallization of KMC, containing $Ca(OH)_2$, organic impurities and $CaCl_2$				8.5815	
. Waste water from prod. of PCC, containing HCl, PCC, organic impurities, NaCl, $NaHSO_3$				46.4382	
. Waste water from filtration and washing of PCA, containing PCA, organic impurities, ammonium, NH_4Cl, 4-phenolsulphonate Na, derivate				5.550	
<u>Solid waste</u>					
. from prod. of FH.HCl, containing phenylhydrazine bisulphonate Na, NaCl, Zn, bleaching clay					0.190
. from prod. of KMC, containing $CaCO_3$, anorganic impurities, $CaCl_2$					0.295
Total	9.158	1.0000	0.674	60.570	0.485

Chloridazone
(Burex 80)

The total amount of emissions in: Tons/Year

Production: 800 ton/years

Air

. off-gas from prod. of FH.HCl, containing trace amounts of SO_2	not measurable
. off-gas from prod. KMC, containing CO_2 and trace Cl_2 (below 2 mg/m^3)	67.04 ton
. off-gas from drying of Chloridazone, containing ammonia, Chloridazone	472 ton

Liquid waste

. Waste water from crystallization of KMC, containing $Ca(OH)_2$, organic impurities and $CaCl_2$	6865.2 ton
. Waste water from prod. of PCC, containing HCl, PCC, organic impurities, NaCl, $NaHSO_3$	37150.56 ton
. Waste water from filtration and washing of PCA, containing PCA, organic impurities, ammonium, NH_4Cl, 4-phenolsulphonate Na, derivate	4440 ton

Solid waste

. from prod. of FH.HCl, containing phenylhydrazine bisulphonate Na, NaCl, Zn, bleaching clay	152	ton
. from prod. of KMC, containing $CaCO_3$, anorganic impurities, $CaCl_2$	235	ton

Waste water volume : 735 M^3/day

Pollution level (kg a day)

BOD	:	701
COD	:	3336
Water soluble		13344
Water insoluble		137

Intermediates

KMC = Mucochlorine Acid
FH.HCl = Phenylhydrazine-Hydrochloride
PCC = 1-Phenyl-4.5-Dichlorine-6-Pyridazine
PCA = Chloradizone

Composition of technical chloradizone

- Chloridazone (PCA)	min. 88 %
- Iso-PCA (non-effective isomer	6.0 - 8.0 %
- PCC	0.3 - 1.0 %
- NH_4Cl	1.0 - 1.5 %
- NaCl	0.3 - 0.5 %
- 4 phenoxy-1-phenyl-5-chlorine-6-pyridazone	0.2 - 0.4 %
- 4 hydroxy-1-phenyl-5-chlorine-6-pyridazone	0.1 - 0.3 %
- 4.4-diamino-1-phenyl-6-pyridazone	0.1 - 0.3 %

Industrial Explosives

Product name: Danudit

Production of Danudit : 6000 ton/year

Input: in ton/ton product

Raw materials	Input
Nitroesters	0.207
Nitrocellulose	0.0088
$NaNO_3$ + NH_4Cl	0.668
Trinitrotoluene	0.0565
Dinitrotoluene	0.050
Wood flour	0.016
Calcite, carboxymethyl-cellulose, colour	0.002
NaCl	Insignificant

Output

Product: Danudit	:	1.002	
Gaseous waste	:	-	
Liquid waste			
.waste water (acid water from nitro-esters, sewege and cooling water)	:	66.666	m^3/ton product
Solid waste			
. soiled and devalued raw materials (mostly from technology cleaning)	:	0.0025	ton/ton product
		15	ton/year
. soiled and devalued product (mostly from technology cleaning)		0.0038	ton/ton product
		22.8	ton/year

Solid waste is disposed by blasting outside Istrochem

Industrial Explosives

Product name: Harmonit AD

Production of Harmonit AD: 1800 ton/year

Input: in ton/ton product

Raw materials	Input
Nitroesters	0.0963
$NaNO_3$ + NH_4Cl	0.8535
Wood flour, Calcium oxalate, Zincumstearate, Carboxymethyl-cellulose, calcite, colour	0.0627

Output

Product: Harmonit AD	:	1.008	
Gaseous waste	:	-	
Liquid waste			
.waste water (acid water from nitro-esters, sewege and cooling water)	:	66.666	m^3/ton product

Solid waste

. soiled and devalued raw materials	:	0.0020	ton/ton product
(mostly from technology cleaning)	:	3.6	ton/year
. soiled and devalued product	:	0.0025	ton/ton product
(mostly from technology cleaning)		4.5	ton/year

Solid waste in disposed by blasting outside Istrochem

Industrial Explosives

Product name: Polonit V

Production of Polonit V: 1800 ton/year

Input: in ton/ton product

Raw materials	Input
Trinitrotoluene	0.1606
Dinitrotoluene	0.0110
NH_4NO_3	0.7910
Wood flour, Aluminum, carboxymethylcellulose, zincum stearate, color	0.0438
Motor oil	0.0025

Output:

Product Polonit V:	1.002		
Gaseous waste	:	-	
Liquid waste	:	-	
Solid waste			
. soiled and devalued raw materials (mostly from technology cleaning)	:	0.0010	ton/ton product
		1.8	ton/year
. soiled and devalued product (mostly from technology cleaning)	:	0.0070	ton/ton product
		12.6	ton/year

Solid waste in disposed by blasting outside Istrochem

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Lube Oil Additives

Product name: Fenadit 11

Production of Fenadit 11: 2500 ton/year

Input: in ton/ton product

Rawmaterials	Input	Output Product	Output to Air	Output waste water	Output Solid waste
Propylenetetramer	0.350				
Phenol	0.200				
Bleaching clay	0.055				
Sulpher	0.050				
Methanol	0.045				
Calcium hydrate	0.150				
Petrosulfonat 30	0.050				
Petrol technical 80/100	0.020				
Oil raffinate OR 935	0.520				
NaOH liquid	0.050				
CO2 liquid	0.055				
N2 liquid in M^3	10.000				

Output

Product: Fenadit 11 (50% solution of Ca salts) 1.000

By-product: Natriumsulfide ($Na_2S.9H_2O$) 0.604

Gaseous waste

. off-gases after absorption

H_2S : not measurable

Organic substances (methanol, petrol, phenol not absorbed on carbon absorber : not measurable ca. 7 mg/ton Fenadit 11

Liquid waste

. 40% dispersion ad Na(OH) and CaCO3 in oil raffinate and in Fenadit (commission burning in SLOVNAFT)	:	0.050	ton/ton Fenadit 11
		125	ton/year
. waste water (only from technology cleaning)	:	0.032	ton/ton Fenadit 11
		80	ton/year

Solid waste

. 80% of Bleaching Clay + Phenol, Tetromere etc. (to Budimarice)	:	0.069	ton/ton Fenadit 11
		172.5	ton/year
. 25% of petroleum substances (commission burning in SLOFNAFT)	:	0.0008	ton/ton Fenadit 11
		2	ton/year

Sulfenax CBS/MG

Production of Sulfenax CBS/MG : 10,000 ton/year

Calgulated production time : 7200 hours/year

Input: in tons/ton product

Raw materials	Input	Output Product
Aniline	0.445	
Carbon disulphide	0.420	
Sulpher	0.030	
Cyclohexylamine	0.440	
Natriumhypochlorite	3.115	
Caustic Soda	0.050	
Slovanyl 40	0.026	

Output

Product

Sulfenax CBS/MB	1.000

Gaseous waste

. off-gases after the Clausplant:					3750	kg/hr	27000	ton/year
Composition:								
	Sulphurdioxide	SO2:	0.33	Vol%	26.4	kg/hr	190.08	ton/year
	Oxygen	O2 :	1.54	Vol%	90.4	kg/hr		
	Nitrogen	N2 :	76.67	Vol%	2861.0	kg/hr		
	Oxygen	O2 :	13.60	Vol%	587.0	kg/hr		
	Water	H2O :	7.7	Vol%	185.0	kg/hr		
	Hydrogensulphide	H2S :	Max. 10	mg/M3	0.0092	kg/hr	0.0662	ton/year
. off-gases after absorption :								
Composition:								
	Cyclohexylamine		0.8	mg/M3				

Liquid waste

Waste amount: 8.093 ton/hour

Composition :

Water		89.10	Vol%	51918.57 ton/year
Salt	NaCl	10.48	Vol%	6106.69 ton/year
Chlorides	Cl^-	0.36	Vol%	206.77 ton/year
Caustic Soda	NaOH	0.32	Vol%	186.46 ton/year
Organic substances		0.10	Vol%	58.27 ton/year
				58270 ton/year

Total amount: 5.827 ton/ton product

Solid waste

Destilation residue: 0.313 ton/hour 2253.60 ton/year

Sulfenax CB/E

Production of Sulfenax CB/E : 4800 ton/year

Chemical name : N-cyclohexyl-2-benzothiazylsulphen amide

Input: in tons/ton product

Raw materials	Input	Output Product	Output to Air	Output waste water	Output Solid waste
Aniline	0.489				
Carbon disulphide	0.427				
Sulpher	1.435				
Cyclohexylamine	0.546				
Natriumhypochlorite	3.267				
Spolion	3.000				
Oil R-935	0.040				

Output

Product

Sulfenax CB/E	1.000

Gaseous waste

. off-gases after the Clausplant: H_2S max. 1 mg/m^3

Composition:

Sulphur dioxide	SO_2	Vol%	unknown	kg/hr	unknown	ton/year
Oxygen	O_2	Vol%	,,	kg/hr		
Nitrogen	N_2	Vol%	,,	kg/hr		
Oxygen	O2	Vol%	,,	kg/hr		
Water	H_2O	Vol%	,,	kg/hr		
Hydrogensulphide	H_2S	Max. 1 mg/M^3		kg/hr	unknown	ton/year

. off-gases after absorption :

Composition:

Cyclohexylamine	1 mg/M^3	kg/hr	unknown	ton/year

Liquid waste

Total amount	8.7	ton/ton product	41760	ton/year
Waste water from distilation	5.9	m^3/ton of Sx		
Waste water from filtration	2.0	m^3/ton of Sx		
Waste water from absorption	0.8	m^3/ton of Sx		

Composition: Unknown

Solid waste

Waste resins	0.224	ton/ton of Sx	1075.20	ton/year

Production of PP Fibres

	BCF		Staple			
	Virelon	Barmag	V-6,7 dtex	K-17 dtex	PKH-1,3 dtex	Plantex 2
Years capacity: (ton)	10,000	700	2,880	2,880	550	4,000
Input:						
. PP chips	1.0692	1.0355	0.9697	0.9930	1.0840	1.0305
. Color master batches	0.0806	0.0648	0.0769	0.0530	0.0160	0.0279
. Lubrication	0.0135	0.0128	0.0105	0.0105	0.0226	0.0129
Output:						
. Final product	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
. Gaseous waste	0.0003	0.0004	0.0026	0.0026	0.0027	0.0021
. Liquid waste	-	-	-	-		
. Solid waste						
- polymer blocks	0.025	0.025	0.0152	0.0152	0.0137	0.0195
- nudraron fiber	-	-	0.0172	0.0172	0.0447	0.0234
- draron fiber	0.1145	0.0747	0.0117	0.0012	0.0113	0.0134
. Lubrication on the fibre	0.0135	0.0126	0.0075	0.0077	0.0078	0.0075
Output: (total tons on year/bases)						
. Gaseous waste	3	0.28	7.488	7.488	1.35	8.4
. Liquid waste	-	-	-	-	-	-
. Solid waste						
- polymer blocks	250	17.5	43.776	43.776	7.535	78
- nudraron fibre	-	-	49.536	49.536	24.585	93.6
- draron fibre	135	52.29	33.696	3.456	6.215	53.6

PP Fibers

Production of PP Fibers

Output: of waste
(total tons on year/bases)

. Gaseous waste
- Hydrocarbons 27.006 ton/year

. Solid Waste
- polymer blocks 440.587 ton/year
- nudraron fibre 217.257 ton/year
- draron fibre 284.257 ton/year

Total solid waste 942.101 ton/year

Percentage of solid waste in relation with product: 4.484 %

Bleaching Clay

Production of Bleaching Clay : 6000 ton/year

Input: in tons/ton product

Raw materials	Input	Output Product	Output to Air	Output waste water	Output Solid waste
Bentonite	2.095				
Water	27.398				
Hydrochloric acid	1.548				
Output					
Product					
Bleaching Clay		1.0000			
Gaseous waste					
HCL 0.12 % in off-gas			0.931		
Bentonite dust in off-gas			0.0002		
Liquid waste					
Waste water (filtrate with HCl 0.5% and bentonit)				29.420	
Solid waste					
Silica sand (by product for civil engineering)					0.480
Coarse sand and ballast					0.052
Manipulation losses					0.010
Total	31.041	1.0000	0.9312	29.420	0.542

Bleaching Clay

The total amount of Emissions in: Tons/Year

Production: 6000 ton/years

Air

Hydrochloric Acid	5586	ton
Bentonite dust	1.2	ton
NO_x From dryer	3.7	ton

Solid waste

Silica sand	2880	ton (by product for sales)
Coarse sand and ballast	312	ton
Manipulation losses	60	ton

Liquid waste

Waste water	176520	ton

Waste water volume : 1867 M^3/day

Pollution level (kg a day)

BOD	:	33
COD	:	132
Water soluble	:	10032
Water insoluble	:	300

Viscose Rayon

Production of Viscose Rayon : 3500 ton/year

Input: in tons/ton product

Raw materials		Input	Output Product	Output to Air	Output waste water	Output Solid waste
cellulose	$C_6H_{10}O_5$	1.04960				
caustic soda	NaOH	0.88440				
carbon disulphide	CS_2	0.32523				
Sulphuric acid	H_2SO_4	1.45730				
Zinc oxid	ZnO	0.02334				
Ammonia solution	NH_4OH	0.00654				
Natrium sulphide	$Na_2S.9H_2O$	0.04233				
Acetic acid (vinegar acid)	CH_3COOH	0.00160				
Lubricant oil		0.03227				
Output						
Product: Viscose Rayon			1.0000			
Gaseous waste						
Hydrogen sulphide	H_2S			0.04664		
Carbon disulphide	CS_2			0.27859		
Solid waste						
Cakes of Viscose Rayon						1.01866
Other Solid waste						0.07888
Liquid waste					*/*	
Total		3.79034	1.0000	0.32523	*/*	1.09754

/ see following page

/ = No ton/ton figures available:
liquid waste (waste waters)
. alkaline (NaOH, Na_2S, Viscose, Sulpher, Lubrications, Sulfides)
total alkalinity up to 2 g NaOH/l
. Acid (H2SO4, $ZnSO_4$, Na_2SO_4, Non-soluble substances)
total acidity up to 2 g H_2SO_4/l

Viscose Rayon

The total amount of Emissions in: Tons/Year

Production: 3500 ton/years

Air

Hydrogen sulphide	H_2S	163.24 ton
Carbon disulphide	CS_2	975.07 ton

Solid waste

Fibre waste from cakes - desulphurized	138.3 ton
Fibre waste from godets - non - desulphurized	53.6 ton
Colorthreads	3.7 ton
Fibre waste - soiled	10.0 ton
Paper wrappers	20.0 ton
Fibre materials - damaged	5.0 ton
Acid undrawn fibres	13.0 ton
Acid sludges	15.0 ton
Alkalineous sludges	15.0 ton
Xanthogenate waste and damaged filter material	2.5 ton
Cakes of viscose rayon	3565.31 ton
Total	3841.41 ton

Waste water

Waste water volume 4500 M^3/day

Pollution level (kg a day)

BOD	1918
COD	4000
Water soluble	22400
Water insoluble	200

Description environmental performance

Emissions

Pollutant	Amount kg/day	Amount ton/ton prod.	Amount ton/year	Notes
Bleaching clay				
HCL 0.12 % in off-gas		0.931	5586	
Bentonite dust in off-gas		0.0002	1.2	
NO_x		14.4	3.7	
HCl from storage		unknown		
Viscose Rayon				
carbon disulphide		0.27859	975.07	Production
Hydrogen sulphide		0.04664	163.24	3500 ton/year
Sulfenax Old plant				
Cyclohexylamine			10	Production
Sulphur dioxide			144	5600 ton/year
Sulfanax CBS/MG				
Sulphur dioxide	633.6		190.08	Production
Hydrogen sulphide	0.221		0.066	10.000 ton/year
Cyclohexylamine	48		14.454	
Sulfanax CB/E				
				Production
Sulphur dioxide		unknown		4.800 ton/year
Hydrogen sulphide		unknown		Max. 1 mg/M3
Cyclohexylamine	48		7.225	
Fenadit 11				
Hydrogen sulphide		unknown		
Organic substances (methanol, petrol, phenol not absorbed on carbon absorber	ca. 7 mg/ton Fenadit 11			

Pollutant	Amount kg/day	Amount ton/ton prod.	Amount ton/year	Notes
MCPA				
Diethylamine		unknown		
HCL		unknown		
Compound Fertilizers				
NO_x		0.235 gr/ton	60 ??	
Dust		0.323 gr/ton	56.4 ??	
NH_4Cl		unknown		
F		unknown		
NH_3	1.4		0.511	
Triple Superphosphate				
F	0.81?		0.295?	
Dust	180		65.700	
Liquid Multicomponent fertilizer Fostim				
NH_3		unknown		
F		unknown		
Liquid Multicomponent fertilizer				
-		unknown		
Explosives				
NO_x	3.5		1.277	
Nitroesters		unknown		
NH_3		unknown		
Polypropylene fibres				
Hydrocarbons			28.006	Production 15.000 ton/year

Total amount of Emissions Istrochem

In tons/year

Hydrocarbons	-	28
Ammonia	NH_3	0.5
Nitro esters	-	unknown
Nitrogen Oxides	NO_x	67.2
Fluorine	F	0.3
Hydrochloric acid	HCl	5586
Dust	-	143.3
Ammonium Chloride	NH_4Cl	unknown
Diethylamine	$(C_2H_5)_2NH$	unknown
Hydrogen sulphide	H_2S	163.90
Cyclohexylamine	$C_6H_{11}NH_2$	21.68
Sulphur dioxide	SO_2	190.08
Carbon disulphide	CS_2	975.07

Effectivity of the waste water treatment plant

Average of the first six months of 1992

Appendix 11

		Input	Output	Licenses
PH		4.62	6.7-7.9	4.5-8.9
Non-soluble dry	105 °C	79.0	24.3	100
Non-soluble dry	500 °C	50.4	16.4	80
Soluble dry	105 °C	3090	3150	5600
Soluble dry	500 °C	2350	2550	4700
COD	mg O_2/l	687	559	1200
BOD	mg O_2/l	186	163	400
Oil	mg/l	21.6	17.5	200
Non polar	mg/l	1.47	0.92	30
Cl^-	mg/l	822	785	1450
SO_4^{--}	mg/l	903	919.4	2000
PO_4^{---}	mg/l	37.6	19.2	
NO_3^-	mg/l	92.0	75.2	
NH_4^+	mg/l	71.7	53.5	
Fe^{++}	mg/l	1.46		
Al^{+++}	mg/l	1.54		
Zn^{++}	mg/l	7.33	0.92	5

Registrated concentrations in the production-plants of Istrochem

Appendix 12

Plant and Department	Chemical name	Structure	TLV norm in Czechoslovakia mg/m³	Average Level in 1991 mg/m³	Maximum Level in 1991 mg/m³
Viscose Rayon					
CS_2 Storage	Carbon disulphide	CS_2	10	14.90	78.8
Sulphidation	Carbon disulphide	CS_2	10	78.00	74.5
	Hydrogen sulphide	H_2S	10	0.97	0.8
Spining	Carbon disulphide	CS_2	10	33.00	48.6
	Hydrogen sulphide	H_2S	10	2.66	3.8
Pressure washing	Carbon disulphide	CS_2	10	8.05	12.9
	Hydrogen sulphide	H_2S	10	0.50	0.5
	Ammonia	NH_3	20	4.00	6.9
Acidic station	Hydrogen sulphide	H_2S	10	1.30	5.8
	Carbon disulphide	CS_2	10	10.54	57.8
Viscose storage	Hydrogensulphide	H_2S	10	0.5	3.0
	Carbon disulphide	CS_2	10	8.5	32.4
	Caustic soda	NaOH			
	Sulphuric acid	H_2SO_4			
	Zinc oxide	ZnO			
	Natrium sulphide	$Na_2S.9H_2O$			
	Acetic acid	CH_3COOH			

no figures available

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Plant and Department	Chemical name	Structure	TLV norm in Czechoslovakia mg/m³	Average Level in 1991 mg/m³	Maximum Level in 1991 mg/m³
Sulfenax (old plant)					
	Carbon disulphide	CS_2	10	26	126
	Hydrocarbons	-	40	2.4	16
	Dust		10	7.2	6.7
	Cyclohexylamine	$C_6H_{11}NH_2$		no figures available	
	Aniline (aminobenzene)	$C_6H_5NH_2$			
	Sulphur				
	Natriumhypochlorite	NaClO			
	Caustic soda	NaOH			
	Oil	-			
Fenadit 11					
	Tetramer of Propylene			No figures available	
	Phenol	C_6H_5OH			
	Bleaching clay		10		
	Sulphur liquid	S			
	Methanol	CH_3OH			
	Calcium hydrate	$Ca(OH)_2$			
	Petrosulphanate 30				
	Petrol-technical 80/100				
	Oil raffinate OR 935				
	Caustic soda liquid	NaOH			
	Carbon dioxide liquid	CO_2			
	Nitrogen liquid	N_2			

Plant and Department	Chemical name	Structure	TLV norm in Czechoslovakia mg/m³	Average Level in 1991 mg/m³	Maximum Level in 1991 mg/m³
Aminex PUR (Herbicide)					
	Ortho - Cresol	$CH_3C_6H_4OH$		No figures available	
	MCA (mono-chloride-acetic-acid)	$CH_2ClCOOH$			
	Calcinated Soda	NA_2CO_3			
	Natriumhypochlorite	NaClO			
	Hydrochloric Acid	HCl			
	DMA (dimethylamine)	$(CH_3)_2NH$			
	Caustic soda	NaOH			
	MCPA 2-methyl-4-chloorfenoxyacetic acid	$HOOCCH_2OC_6H_3CH_3Cl$			

Plant and Department	Chemical name	Structure	TLV norm in Czechoslovakia mg/m^3	Average Level in 1991 mg/m^3	Maximum Level in 1991 mg/m^3
Multi Component Fertilizer (NPK 9-19-19)					
	Chlorine	Cl_2	8	4.3	8
	Anhydrous Ammonia	NH_3	20	5.7	26.8
	Hydrofluoric Acid	HF	1	5.3	8
	Triple superphosphate		10 as dust		
	Monoammoniumphosphate		10 as dust		
	Potassium Chloride	KCl	10 as dust		
	Zeochem mineral	AlSi	10 as dust		
	Dust		10	50-250	272
	Ammonium nitrate	NH_4NO_3	No figures available		
	Sulphuric Acid	H_2SO_4	No figures available		
	Sulphite extract		No figures available		
	Fluorine	F_2	No figures available		
	Ammonium Chloride	NH_4Cl	No figures available		
	Nitrogen dioxide	NO_2	No figures available		
Polypropylene Fibres					
	PP chips		No figures available		
	Colour master batch		No figures available		
	Lubrication		No figures available		

Plant and Department	Chemical name	Structure	TLV norm in Czechoslovakia mg/m³	Average Level in 1991 mg/m³	Maximum Level in 1991 mg/m³
Industrial explosives					
	Nitro esters (nitro glycerine)	$C_3H_5(ONO_2)_3$	0.5	1.8	5.7
	Nitrogen oxide	NOx	10	5.5	13.4
	Anhydrous ammonia	NH_3	20	36	150
	Natrium nitrate	$NaNO_3$	as dust		
	Ammonium chloride	NH_4Cl	as dust		
	Woodflour		as dust		
	Calcite		as dust		
	Aluminium	Al	as dust		
	Dust		10	11.7	32
	Nitrocellulose	$C_{12}H_{14}(ONO_2)_6O_4$ to $C_{12}H_{17}(ONO_2)_3O_7$			
	Trinitrotoluene	$[C_6H_3CH_3(NO_2)_3]$			
	Dinitrotoluene	$[C_6H_3CH_3(NO_2)_2]$			
	Carboxymethylcellulose			No figures available	
	Colour				
	Salt	NaCl			
	Zincumstearate	$Zn(C_{18}H_{35})_2)_2$			
	Ammonium nitrate	NH_4NO_3			
	Oil				
Bleaching Clay					
	Raw Bentonite		as dust		
	Bleaching clay		as dust		
	Dust		10	66	121
	Hydrochloric acid	HCl	8	0.9	1.7

Threshold Limit Values

Chemical name	Structure	TLV norms in the Netherlands Mg/m³		ppm
-Viscose Rayon				
. cellulose	$C_6H_{10}O_5$	-		-
. caustic soda	NaOH	2 mg/m³	C	
. carbon disulphide	CS_2	60 mg/m³	H	20 ppm
. Sulphuric acid	H_2SO_4	1 mg/m³		
. Zinc oxide	ZnO	5 mg/m³	as smoke	
. Ammonia solution	NH_4OH	18 mg/m³		25 ppm as NH_3
. Natrium sulphide	$Na_2S.9H_2O$		no settlement	
. Acetic acid (vinegar acid)	CH_3COOH	25 mg/m³		10 ppm
. Lubricant oil	-	-		-
. Hydrogensulphide	H_2S	15 mg/m³		10 ppm
- Sulfenax				
. Aniline (aminobenzene)	$C_6H_5NH_2$	19 mg/m³	H	5 ppm
. Carbon disulphide	CS_2	60 mg/m³	H	20 ppm
. Sulphur	S		no settlement	
. Cyclohexylamine	$C_6H_{11}NH_2$	40 mg/m³	H	10 ppm
. Natrium hypochlorite	NaClO		no settlement	
. Caustic soda	NaOH	2 mg/m³		
. Oil		5 mg/m³		

Chemical name	Structure	TLV norms in the Netherlands Mg/m³	ppm
- Fenadit 11			
. Tetromer of Propylene			
. Phenol	C_6H_5OH	19 mg/m³ H	5 ppm
. Bleaching clay		10 mg/m³ as dust	
. Sulphur liquid	S	no settlement	
. Methanol	CH_3OH	260 mg/m³ H	200 ppm
. Calcium hydrate	$Ca(OH)_2$	5 mg/m³	
. Petrosulphanat 30			
. Petrol - technical 80/100			
. Oil raffinate OR 935			
. Caustic soda liquid	NaOH	2 mg/m³	
. Carbon dioxide liquid	CO_2	9000 mg/m³	5000 ppm
. Nitrogen liquid	N_2	no settlement	
- Aminex PUR (Herbicide)			
. Ortho - Cresol	$CH_3C_6H_4OH$	22 mg/m³ H	5 ppm
. MCA (mono-chloride-acetic-acid)	$CH_2ClCOOH$	no settlement (toxic)	
. Calcinated Soda	NA_2CO_3	no settlement	
. Natriumhypochlorite	NaClO	no settlement	
. Hydrochloric Acid	HCl	7 mg/m³ C	5 ppm
. DMA (dimethylamine)	$(CH_3)_2NH$	18 mg/m³ 10 ppm	
. Caustic soda	NaOH	2 mg/m³	
. MCPA 2-methyl-4-chloorfenoxyacetic acid	$HOOCCH_2OC_6H_3CH_3Cl$	no settlement (harmfull)	

Chemical name	Structure	TLV norms in the Netherlands Mg/m³	ppm
- Multi Component Fertilizer (NPK 9-19-19)			
. Ammonium nitrate	NH_4NO_3	no settlement	
. Triple superphosphate		10 mg/m³ as dust	
. Monoammoniumphosphate	$NH_4H_2PO_4$	10 mg/m³ as dust	
. Potassium Chloride	KCl	10 mg/m³ as dust	
. Sulphuric Acid	H_2SO_4	1 mg/m³	
. Zeochem mineral	AlSi	10 mg/m³ as dust	
. Sulphite extract			
. Fluorine	F_2	2 mg/m³	1 ppm
. Ammonia	NH_3	18 mg/m³	25 ppm
. Ammonium chloride	NH_4Cl	10 mg/m³ as smoke	
. Nitrogen dioxide	NO_2	4 mg/m³	2 ppm
- Polypropylene Fibres			
. PP chips			
. Colour master batch			
. Lubrication			
_ Bleaching Clay			
. Raw Bentonite			
. Water			
. Hydrochloric acid	HCl	7 mg/m³ C	5 ppm

Chemical name	Structure	TLV norms in the Netherlands mg/m³	ppm
- Industrial explosives			
. Nitro esters (nitro glycerine)	$C_3H_5(ONO_2)_3$	0.5 mg/m³ H	0.05 ppm
. Nitro cellulose	$C_{12}H_{14}(ONO_2)_6O_4$ to $C_{12}H_{17}(ONO_2)_3O_7$	no settlement	
. Natrium nitrate	$NaNO_3$	no settlement	
. Ammonium chloride	NH_4Cl	10 mg/m³ as smoke	
. Trinitrotoluene	$[C_6H_3CH_3(NO_2)_3]$	no settlement	
. Dinitrotoluene	$[C_6H_3CH_3(NO_2)_2]$	no settlement	
. Woodflour			
. Calcite			
. Carboxymethylcellulose			
. Colour			
. Salt	$NaCl$		
. Zincumstearate	$Zn(C_{18}H_{35})_2)_2$	10 mg/m³	
. Aluminium	Al	10 mg/m³	
. Ammonium nitrate	NH_4NO_3	no settlement	
. Oil			

Noise levels

Advise whearing of ear-protection: 80 dB/A

Limit under Act: 85 dB/A

Plant	Technology part	Average level in dB/A
Viscose Rayon	Sulphidation	87
	Spinning room	90
	Winding room	88
	Compressor station	95
	Viscose room	86
	Converter room	98
	Cooling room	87
	Spinnerets cleaning	100
Chloridazone	KMC prodcution	87
	PCC production	85
	Grinding and finalizing	84
MCPA	In the hall	85
Compound Fertilizer	Production hall	90 - 100
	Compressor station	95
Bleaching Clay	Grinding finalizing	85
Polypropylene I	Secondary materials treatments	100

Plant	Technology part	Average level in dB/A
Polypropylene II	Baleron - KK machines	95
	Baleron - Verdol machines	95
Polypropulene III (mothballed)	Extruders - hall	89
	Spinning - hall	80
	Drawing lines	50
	Waste processing	103
Masterbatches	Production hall	88
Polypropylene IV	Virelon - Barmag machines	110
	Virelon - Plantex machines	96
	Virelon - Verdol machines	93
	Dietze - Schell 100 line	90
Utilities	Pneumatic station	95
(PP I.II.IV)	Cooling room	100