ISMA* Technical Conference

Sandefjord, Norway
8-11 September 1970

**In 1982, the name of the International Superphosphate Manufacturers' Associations (ISMA) was changed to International Fertilizer Industry Association (IFA).*

International Fertilizer Industry Association - Secretariat: 28 rue Marbeuf - 75008 Paris - France
Tel. +33 1 53 93 05 00 - Fax +33 1 53 93 05 45/47 - ifa@fertilizer.org - www.fertilizer.org

LTE/70/11

AIR POLLUTION ABATEMENT IN THE FERTILISER INDUSTRY

By :

Erik Thurmann-Nielsen,
Norsk Hydro,
Norway

Air pollution is by no means a new problem, records show there were efforts to control it as early as the 14th century. But where this once was a matter of concern in a few unusual situations, population growth and concentration now give pollution control a greater importance and urgency in most industrialized countries. Nor is the answer any longer straightforward. While our technical resources for diagnosis and prescription are greater than ever, the increasing diversity and complexity of human activities make both vastly more difficult. Besides, the past decade has seen a significant change in the PUBLIC's attitude towards air pollution. Formerly the tendency was to deplore smog, but to regard it as one of the inescapable adjuncts of urban life. Now there is a growing realization that smog, in addition to being a vexatious nuisance, may indeed present hazards to health and that in any case pollution of the air will inevitably worsen unless something is done about it.

It serves no purpose here to recapitulate the many and well known general aspects of air pollution, however interesting these might be. Let us consider it as a fact that industry is no doubt responsible for a considerable share of total air pollution.

It is predictable that contamination from industry can probably never be entirely eliminated. It can, however, be measurably reduced from the present levels, and it is my belief that the needs of modern industry can be met without seriously affecting the balance of nature, and that the interests of technology and ecology need not conflict. The question is whether we are willing to make the effort and pay the price.

Hope for continued improvement is spurred by the certain knowledge that pollution problems are not being ignored. Legislation in this field is expanding in several countries, and there is a growing international understanding of the global aspects of the problem. Universities and institutes have made their facilities available for research and study and in local communities watchdogs are tackling the problems with increasing knowledge and understanding. Equally significant, many industrial organizations are spending sizeable sums and devoting some of their most talented people to the search for corrective measures.

Norsk Hydro, as one such organization, has for many years been deeply concerned about the problems of pollution, and this paper will deal with the air pollution abatement programs at their chemical works at Herøya, which is in fact the biggest industrial plant in Norway.

The chemical works at Herøya, whose full name is Eidanger Salpeterfabriker, mainly produces nitrogen fertiliser, as calcium nitrate, urea and compound fertilisers. Their production involves two big ammonia plants based on oil and light naphtha, a nitric acid plant and also the biggest limestone quarry in Norway. Besides, there is the production of magnesium metal from seawater, and a plant producing polyvinylchloride, and related production of chlorine, hydrogen chloride and carbide. It is therefore understandable that all these complex production processes concentrated on an area of 250 acres, could certainly contaminate the air to a great extent.

The main source of pollution is dust particles, resulting from process operations such as crushing, grinding and sieving, transportation, drying and calcining (carbonating), unloading of raw materials and packing. Tail-gases from the stacks contain the easily visible yellow-brown plume of nitrogen oxides, chlorine and hydrogen chloride, sulphides, fluorine and sulphur dioxide from oil-fired dryers and boilers in the steam delivery plant. Ammonia escapes from numerous sources.

It is a well known fact that the dilution and dispersion of pollutants in the air depend not only on the local topography, but also on meteorological conditions. The prevailing wind conditions and air stability are especially important. And in these respects the conditions at Herøya are not optimal. Very often inversion layers, even on sunny, summer days, create an odorous haze which can be an annoying nuisance in surrounding areas.

Production, especially of fertilisers, has expanded rapidly, and pollution, which was once a tolerable nuisance to the surrounding areas, has become a problem. Something has had to be done and the following is a scheme for a control program based on the experiences in the above mentioned Norsk Hydro factories during the last 10-15 years.

WHY ABATE POLLUTION ?

There are indeed some very good reasons why a company should do everything feasible to abate pollution.

1. NEIGHBOURHOOD

The company should identify itself as a member of the community surrounding its operations and therefore do as much as possible to be a good neighbour. And since the vast majority of the employees live in the surrounding areas, any contamination permitted to go unchecked is literally "fouling the company's own nest". The company is its own neighbour. The plant manager and its employees breathe the same air, so do their friends and families.

2. LEGISLATION

Governmental restrictions in the air pollution field are becoming increasingly stringent, and if a company can keep ahead of the law by not permitting any known source to pollute more, or even not as much as, an anticipated limit, then excellent cooperation with the officials will always be ensured.

3. INTERNAL PROTECTION

In the works there are a lot of high voltage outdoor stations. The polluted dust may stick to the insulators and will be partly dissolved by air moisture, creating electrolytes. In summer it is possible to clean the insulators from time to time with water jets, but in winter, with temperatures below zero, this is not possible. The dust layers on the insulators build up, then suddenly there come a day with a higher temperature. The ice melts and the electrolytes created may cause short-circuits with the resultant power black-outs. When operating big units, as for instance ammonia plants, a black-out means the loss of at least a day's production and therefore this is a very good reason for putting a lot of money into measures which may prevent such occurences.

HOW CAN AIR POLLUTION BE ABATED ?

When the management of a company fully appreciates the air pollution problem and its complexity, with the consequences involved, the only reasonable thing to do is to organize a control program. The organization of a control program, as with practically everything else in a chemical plant, ought to have the plant manager at the top.

The plant manager should put an individual in charge of pollution control, and the man with this responsibility needs the authority to sell to and enforce pollution control on operating line management. He also needs a good knowledge of all plant processes, which indicates that this man should be a former plant engineer. If it is a big company with many pollution

problems, this man would be the head of what is going to be called the Air Pollution Abatement Department (APAD).

Not every plant will have individuals with the proper grounding in what is coming to be called "environmental engineering". The management may therefore seriously consider ways of training personnel, by means of courses for instance, in pollution abatement.

Norsk Hydro established its APAD several years ago, and the first obvious goal was to organize a waste sampling and measurement program. A small technical staff was trained in sampling and measurement techniques and adequate sampling devices were provided. Some standard devices can be bought from suppliers in this field, others were designed and constructed in our own departments.

The prime duty of APAD has been to provide the plant manager with an up to date appraisal of the plant's air pollution potential. An ideal study includes a block diagram of every processing operation, with exhaust points to the atmosphere clearly indicated. At these points, the probable constituents of the exhaust material and an estimate of constituents concentrations should be noted. When air pollution control equipment is installed, this should be identified on the block diagram - showing type, capacity and efficiency. This gives more detail than the manager needs, but is useful to the technical staff for other purposes.

This summary diagram should not be restricted only to those exhaust materials with known emission of chemicals or particles. The exhaust material from every process should be inventoried, and the emission survey should include visible emission (even if it is only water vapor), odorous compounds (even if barely detectable in the neighbourhood) and particulate emission.

The next step was to devise a plan of campaign. APAD together with the plant engineers had to work with each departmental manager, studying ways of reducing waste by means of operating procedures, process modifications and - more stringent housekeeping. Progress reports - charts, graphs and written summaries - should be given a wide distribution. It is very important that the line employees should be informed early of the pollution control program, and the role they must play in its successful implementation. It is a basic rule that every process department should be responsible for its own pollution. APAD's function is control and guidance and it serves basically as the advisor and trouble-shooter when the plants need help.

APAD also provides technical services for other departments in the plant. To resolve air pollution problems, it must select the appropriate control equipment, and later push the button that

puts the installation into operation. APAD also supervises the starting up of the equipment machinery and performs efficiency tests, and as "the internal officials" APAD may have to do a little police work to ensure that the equipment is in constant use. It is a well known fact that, during peak production, when there are process snags or when equipment is giving trouble, production supervision concentrates its attention on making the product. APAD, with its knowledge of the waste emission in the plant, of regulations and of powers of their enforcement and of the neighbourhood opinion, may have to focus attention on non-productive pollution control equipment.

All efforts may be in vain if the motivation for air pollution control does not get down to the man who turns the valve. It is the fundamental responsibility of first-line supervision to transmit the management's concern for pollution control to operating personnel. This concern must be emphasized as strongly as is the requirement for making safety regulations. There should be no indication that pressure to meet a schedule or to increase production justifies bypassing control equipment.

The most important job of first-line supervision personnel, in relation to air pollution, is operator training. Operators must know where the pollution control devices are, why they are there, how to operate them, and when to draw attention to maintenance problems. They should be familiar with normal levels of emission and should know where to report any abnormal emission.

To do its job in a satisfactory way APAD therefore must build up expertise in the control equipment field and collect the more specialized engineering information. It must make itself familiar with common types of control equipment and the different suppliers, and know about advantages and disadvantages of each. Furthermore it must be familiar with the pollutants in question and know the determinative parameters associated with them. It may then be able to make the right choice independent of whatever the suppliers may recommend.

When a plan has been worked out, including the installation of the correct equipment and where this can most effectively (and most cheaply) be done, it will always be necessary to organize a control system that ensures operation at the maximum efficiency level of the equipment.

Where dust emission is concerned, monitoring instruments are expensive and in most cases not yet fully developed. The APAD staff, which is intended to be effective but small in numbers, will not have the opportunity to take measurements as often as is necessary to ensure full control. One possibility is then to let the plant's own shift personnel supervise their own plant's emission by what is called visual control. As a routine they can look

at their stacks from time to time. If anything is seriously wrong this is, with some experience, easy to detect by eye. If the plume seems a little unusual they can call for APAD to make measurements.

It is one thing to have the proper equipment installed, quite another to maintain it. If not properly maintained you will be taken by surprise by shock emissions from time to time. Bagstores for instance, may contain hundreds, maybe thousands, of bags, and if only one of these breaks up, a considerable amount of dust will escape. We have therefore found it necessary to establish what we call a prophylatic maintenance system.

The bags are exchanged with new ones every 3 months, 6 months or more, depending on the particular conditions. It is very important to exchange all bags in any one compartment all at the same time. The used bags are then sent to the bag workshop where the bags are cleaned, checked by light permeability and repaired where this can be done. Then the useable bags are put into compartment sets ready for re-use. After operating this system for 2 years, not only are shock-emissions history, but bag consumption has been reduced by 50% ! When operating bagstores using about 12,000 bags a year, and each bag's value is about 50,- kr., an advanced maintenance system gives a considerable payback.

An environmental engineer must study many professions. Among other things he will have to go into meteorological techniques. APAD has set up a number of meteorological stations where monitoring instruments log wind force, wind direction and air temperature at several altitudes. The observations are put into a computer and we are trying to work out a mathematical model which we hope may be able to give the answers to some quite important questions. First we want to get a picture of the dispersion systems that decide the fallout and ground level concentration of gases in the surrounding areas.

Furthermore there is the matter of calculation of stack heights. How high should a stack for a new process be, without increasing ground level concentration at given distances from the plant. On the other hand, how much can we allow the stack to pollute by expanding a process without increasing the ground level concentration ?

In connection with these observations we also have a number of stations in the surrounding areas measuring the dust fallout and a monitoring instrument logging sulphur dioxide concentrations.

PUBLIC RELATION ASPECTS

It is important for management to realize that pollution

is not entirely a technical problem, but one which involves people. As such, industry cannot expect as a matter of course, that events will follow a logical pattern. Actually, psychology i.e. "public relations" plays an important part in pollution problems. Industry must realize that the public is insufficiently "educated" in the facts of pollution to be in a position to weigh up a given situation objectively. Because of the public's inability to distinguish between the health aspects of pollution and those relating solely to its comfort, or to economic matters, and because of the widespread publicity on the subjects of pollution, the public is easily panicked. This state of anxiety and fear needs to be dispelled by giving the public a more realistic picture of pollution problems. The public must first come to realize that industrial areas will always be contaminated to some extent, unless industry is evicted. All that can reasonably be expected on the part of industry is a reduction in pollution to a tolerable level. It is important that the public is made to realize that industry is not its enemy, but that instead it is a provider of jobs, commodities and tax income for the community. The public must also be made to realize that the control of pollution takes time. Apart from economic and technical problems, time is required to design, construct and install new control equipment. It is important to sell the plant management's ideas about these questions by direct communication with the community. Installation of new equipment should be publicized. Local officials might be invited together with the press to inspect the equipment. Lectures on the difficulties about designing suitable equipment, how much it costs, why the plant management cannot afford to make the air totally clean, should be given and also publicized. Open-house days plant tours, newspaper articles, community events, talks, are among the means of telling the plant management's story to the public. Public relations are therefore also among the many responsibilities of APAD.

TECHNOLOGY AND COSTS

The practical limitation on air pollution control is cost, not technical feasibility ; the distinction between these two factors tends to be blurred in public debate. Technology is available for controlling most pollutant emission to any degree desired. Control systems for every possible application are not always commercially available, and certain types of control installation have never actually been built except, perhaps, on a laboratory scale. Nevertheless, the principles involved are known and engineering development can be carried out if desired. But it costs money. There will always be the balance between what is technological possible and what industry can afford to pay for control equipment without eliminating the profit. The prime requirement for control is therefore a revision of ideas on what constitutes a reasonable cost. No new

usable basic principles of air pollution control should be expected to appear. Rather, advances will have to be made in the application of the known principles to produce more efficient and economic control systems. Furthermore, radical and early reductions in the cost of air pollution control are not to be expected merely as a result of developments in methods of treating waste gases. In many instances, the greatest opportunity for the economic control of air pollution lies in changing the process producing the pollutant, either reducing the formation of the pollutant or concentrating it into a considerably smaller volume of waste gases.

Norsk Hydro has invested (over the last ten years) about 30 million Norwegian kroner in air pollution control equipment. That amounts to about 3% of the total capital investment. Of the actual capital investment in typical air pollution control systems, only about one-third of the total represents the cost of the control devices themselves. The rest goes into installation and into such auxiliary items as fans, pumps, ducting, etc. Adequate figures on operational costs are difficult to calculate, but as a rule of thumb, the total annual cost for particulate collection systems, including amortization, can be taken as one-third of the capital investment.

So far, this paper has dealt with the organization we have in Norsk Hydro to take care of our air pollution problems. APAD numbers only 7 men of whom 3 are skilled engineers. A technical staff of 4 carry out measurements, otherwise we depend on the plant's various laboratories, and the work consists mainly of co-ordinating and directing the jobs to the right places. The evaluation of the results, however, is made by APAD itself. APAD controls more than 100 stacks or other known sources.

It can be argued whether the above described organization is the best one, but in any case Norsk Hydro has found it a system which works well. As far as the results are concerned, it should be mentioned that the total emission of dust has been reduced from 16 tons a day in 1963 to about 6 tons a day today in spite of a very rapid expansion of production over the same period. We do think that, where dust emission is concerned, we have achieved what is technically and economically possible. No stack nor any other controllable source, contains more than 100 mg dust per cubic meter. But in total it still amounts to the considerable amount of 6 tons per day. Nitrogen oxides have been reduced from 18 to about 12 tons a day calculated as nitrogen, but still give us trouble. As you are certainly well aware, a further reduction of the nitrogen oxides means installation of expensive high pressure absorbers. But we probably shall have this investment after all, due to forthcoming stricter regulations. Other control systems such as catalytic oxidation, alkaline absorption and so on, are still too costly because

of the vast amounts of gases. Sulphur dioxide emission has in the recent years steadily increased because of the expanding need for steam. We have no installations for limiting sulphur dioxide except in the oil used for ammonia production, where there is conversion in a Claus-plant to sulphur. Last year we therefore emitted about 20 tons of sulphur dioxide per day. We now, however, use an oil with a sulphur content not exceeding 1% and the emission is now reduced by about 50%. But we have indeed another problem. Acid gases such as nitrogen oxides or sulphur dioxide, not to mention chlorine or hydrogen chloride, react with ammonia to form very finely dispersed particles, which eventually create a haze causing a definite nuisance in surrounding areas. The solution to this problem should be more stringent housekeeping as far as ammonia is concerned, and to reduce the alkaline component in the process. We are doing a lot of research work on this problem, the solution of which, however, lies in the future.

DISCUSSION

Mr. E. THURMANN-NIELSEN (Norsk Hydro, Norway) : I shall be very brief in my introductory remarks. You will no doubt have observed that the views I have on these very important problems are applicable to any type of chemical industry, not necessarily the fertiliser industry only.

I have tried to express some general opinions on the air pollution problems, which I believe are not unfamiliar to others working in this field. Mainly, however, I have described the control program we have organised to abate the pollution, as outlined in detail in my paper. I feel that we have succeeded in establishing a system that works smoothly and well, although far from perfect. It is, however, questionable if it could be directly adopted by other companies. I am sure each company will have to tailor-make its own system, because of the many variables involved. For instance, the individuals available, the nature of production, the size of the company, and so on.

I shall illustrate how we have done so far by showing a few slides, and leave to you to decide whether our efforts have proved successful or not.

Slide 1 - First an overall picture of our works at Herøya. You can easily recognise the yellow-brown plume from our nitric acid plant in the centre of the picture and please observe the typical haze due to an inversion layer built up over the neighbourhood.

Slide 2 - This is the interior of one of our sampling stations in the residential area. It contains a Picoflux sulphur dioxide recorder, the signals being transferred to a magnetic tape together with data from an automatic weather station recording wind force, wind direction and temperatures at different heights.

Slide 3 - This is a British Standard Gauge dust fall-out sampler.

Slide 4 - This only to show the difficulties when sampling stack emissions. It is a stack of one of our compound fertiliser plants.

Slide 5 - In this diagram the green curve represents the development over the recent years of our total emissions of particulate matter, calculated as an average over the year. You will observe that the emission was about 16 tons a day in 1962 and decreased rapidly in 1964 to about

5 tons. During the following considerable expansion of production, there is a slight increase but we are now down to 5 tons again. This we find an acceptable level and the best we possibly can do without ruining the economics of production.

The other curves indicate the dust fall-out calculated in grams per 100 square meters per 30 days. The blue curve represents a station in the centre of the works, and it is interesting to see how this curve follows the emission curve.

The brown and yellow curves represent stations in the residential area and they are reasonably beneath the red line with the crosses, which indicates the Swedish permissible limit for dust fall-out in residential areas.

Slide 6 - This diagram shows a similar development relating to some gases. The red curve represents the nitrogen oxides from the nitric acid plant, the brown and yellow curves represent the emissions of chlorine and hydrogen-chloride and the blue one is the sulphur dioxide emission that naturally increases with the increasing consumption of oil for combustion.

However, you will have observed from my paper that by buying oil with a maximum sulphur content of 1%, we can expect the emission to decrease to about 10 tons per day which may be considered reasonable. Please observe the black thin curve indicating the production increase during the same period.

I should finally like to draw your attention to the following points I have made in my paper, and which I believe are very important points indeed viz. :

> Contamination from industry can probably never be entirely eliminated. It can, however, be measurably reduced from present levels. But there will always be the extremely difficult balance between what is technically feasible and what is economically possible. It is this difficult choice which we must make the Public understand.

Mr. R.I. HECK (I.M.C. Company, U.S.A.) : Mr. THURMANN-NIELSEN's description of the effluent abatement programme adopted by Norsk Hydro indicates that his company recognises its responsibility to the community in which it operates, and also recognises its responsibility to its shareholders.

The discussion of effluent abatement falls in the same area as discussion on "motherhood" and "country". Everyone

is interested in the subject, and everyone is an expert on the amount of emission that his neighbour should be permitted to exercise. It is one area of our industrial activity where the general public feels the need to become involved in decisions that affect our investments and our profitability.

In the United States today it is almost impossible to find a newspaper, a TV news report, or radio news report that does not mention the subject in some way or another. Most recently in the U.S. even the "champion of all causes" Mr. Ralph NADER has turned his critical eye toward the subject. The formation, several years ago, of an Air Pollution Abatement Department in the Norsk Hydro organisation indicates this company's recognition of the serious consequences to the community of unrestricted process emission and of their own welfare in the community.

The paper presented by Mr. THURMANN-NIELSEN discusses the philosophy of abatement control and abatement control management, and is not concerned with operational details or data. Since the paper limits itself to general principles of abatement management, I will restrict my remarks and questions to this area.

Mr. THURMANN-NIELSEN states on page 3 that "a control programme ... ought to have the plant manager at the top". He states further on page 4 that "every process departement should be responsible for its own pollution". Since the plant manager and process personnel are therefore responsible for both product cost and effluent control, my first question is "Have the plant management personnel cooperated adequately in abatement control programmes in spite of the fact that the procedures and investments in these programmes are certain to increase operating costs and plant performance ?"

My second question concerns the effectiveness of the public relation activities instigated by Norsk Hydro. On page 7 the author states that "the public must first come to realise that industrial areas will always be contaminated to some extent, unless industry is evicted. All that can reasonably be expected on the part of industry is a reduction in pollution to a tolerable level". He also states that "it is important to sell the plant management's ideas about these questions by direct communication with the community. Installation of new equipment should be publicised. Local officials might be invited together with the press to inspect the equipment ... Open-house days, plant tours, newspaper articles, community events, talks are among the means of telling the plant management's story to the public". My

second question is : "Has this method of influencing public opinion been effectively tested and, if so, what degree of success has been attained ?"

In general the attitude of the public in the United States has been "do not confuse me with facts, my mind is already made up".

On page 8, the author states that "in many instances, the greatest opportunity for the economic control of air pollution lies in changing the process producing the pollutant". I wonder if he could give us a specific example of a process change that has effectively improved process emission at their plant.

My fourth and final question is in regard to the reduction in emission reported on pages 8 and 9. As operational staff I believe that we would all agree that a reduction in particulate emission from 16 tons per day to 6 tons per day is a significant redution. The same is true of a reduction in NO_2 emission from 18 to 12 tons per day.

I wonder, however, if the people residing in the area where this fall-out occurs have recognised the significance of this reduction, or do they continue to see effluents being emitted and, therefore, fail to recognise the appreciable improvement that has been made.

Mr. THURMANN-NIELSEN : The answer to Mr. HECK's first question is positive. Today the operating management personnel cooperate very well indeed, but it is no secret that a lot of progress had to be made. It has been a question of motivating people to consider the new philosophy that control equipment must be looked upon as a necessary part of the process chain. Further, we have had difficulties of co-operation between the different production divisions. But the question of internal protection described in my paper on page 3 has changed all that. The consequences of a total power black-out have put the right pressure in the right places and I am glad today to say that we now have no problems at all concerning the co-operation.

Your second question concerning influencing public opinion is rather difficult to answer. This is, as you are certainly well aware, a very slow process. I cannot state that our methods have been effectively tested but we feel that more and more people understand to a certain degree how extremely difficult the problems of air pollution are. For instance where the newspapers formerly demanded that industry and industry alone should do the most impossible things to prevent smoke emissions, today you can read in the same newspapers that air pollution and air pollution abatement is

not the concern of industry alone but the concern of society, that governmental aid and funds must be provided in the struggle for cleaner air. In other words the taxpayers' money is now involved in public debate and this really means a psychological change in public opinion.

Then you asked for examples of the possibilities of reducing the emissions by process changes. The simplest example is the recirculation of the gas in a rotary kiln to reduce the amount of gas emission, resulting in the greater effectiveness of existing control equipment. In the compound fertiliser plant, the new prilling process instead of granulation has reduced the emission of particulate matter considerably, although this was not the reason for changing the process. We are now working on a project where the tail gas from the closed plant in the ammonia production line, which is a little too rich in hydrogen sulphide for our liking, should be brought together with another tail gas containing chloride from the magnesium plant. The hydrogen chloride thus formed should then be scrubbed out with water before emission of the combined gases to the atmosphere. But what I had in mind in making the statement to which you refer was the ferro silicon industry. As you know you still have to use open furnaces for the production of this material, resulting in vast amounts of gases which cannot be cleaned economically. Much research work has been done in this particular field just to alter the process so that you can close the furnace and bring the gas quantity to a reasonable level.

Your last question is a very pertinent one indeed. It is difficult to give a straight answer. I think we must consider it a fact that figures of this kind do not impress the man in the street. It is what he can see with his eyes or smell with his nose that is important to him. As long as he can see what he believes to be smoke, even if it is mostly steam or mist or the haze due to the reaction between acidic and alkaline components in the atmosphere, he will complain. He is not interested if you tell him that the emission of particulate matter has been reduced from 16 to 5 tons per day. 5 tons are still about 5 tons too much as long as he does not have the same air quality as you find on a mountain. I think that partly answers the question.

Dr. K. TROBISCH (Farbwerke Hoechst, Germany) : My first question is related to your last remark and concerns residual gases from nitric acid manufacture. I should like to ask whether, with regard to optical requirements, you are interested in catalytic reduction of emissions and also in what relation the oxidation stages of NO and NO_2 occur with

you in the residual gases emitted.

I should also like to ask a second question. Have you suppressed in the locality vegetation damage due to leaf irritation due to fertiliser dust and have you difficulties due to vehicle corrosion ?

Mr. THURMANN-NIELSEN : We have considered seriously through the years what we should do with the nitrogen oxides. It is an optical problem and maybe there could be another problem too but due to our main absorbing capacity being with atmospheric air in the granite towers. We have such a vast amount of tail gases that, because of the economies of catalytic oxidation, this method is not feasible. However we are increasingly going over to pressure absorbers and, when this development is complete I think we must consider again for instance the catalytic oxidation of the tail gas.

Regarding the question of any difficulties in the neighbourhood. We have observed this year that the trees are a little damaged and we are investigating this now. However, so far we have not come to any conclusion. It could be nitrogen oxides, it could be sulphur dioxide, it could be chloride, it could be HCl, it could be fluorine. But I suppose that next year a conclusion will be reached by the experts in this field.

We have corrosion but not only due to nitrogen oxides. I think hydrogen chloride is the worst one for cars, which should not be parked outside the works because of dust fall-out and corrosion. That is a big problem.

Mr. LEFEVRE (Ugine Kulhmann, France) : Has APAD also been concerned with noise nuisance ?

Mr. THURMANN-NIELSEN : Yes we have indeed. The noise problem is quite difficult. We have I do not know how many ventilators, it must be thousands, and they are a most difficult problem. In the ammonia plant, when there is a break in production and compressed air is expanded into the atmosphere, there is a horrible noise and we have had complaints. However, we have managed to reduce the noise to a certain level by building in large absorbers for the expanding air.