

Current Problems of Working Safety and Medicine in the Processing
of Vinylchloride
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Current Problems of Working Safety and Me

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INFORMATORY DISCUSSION

CONCERNING

CURRENT PROBLEMS OF
WORKING SAFETY AND MEDICINE IN THE
PROCESSING OF

VINYLCHLORIDE

Section 2 between indicated brackets, Page 12-13. Section indicated
between brackets Page 40-77.

ORGANIZED BY THE PROFESSIONAL COOPERATIVE SOCIETY
OF THE CHEMICAL INDUSTRY

on June 23, 1975 in Frankfurt, West Germany

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The attached partial translation of a meeting of The German Professional Cooperative Society of the Chemical Industry is provided by Union Carbide Corporation in the interest of improved vinyl chloride safety. The translation was done by the Ralph McElroy Company in Austin, Texas. Union Carbide Corporation assumes no responsibility for its accuracy.

Questions regarding its content should be referred to the Professional Cooperative Society of the Chemical Industry in Germany.

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2. Round Table Discussion on Measures for Avoiding Effects Adverse
to Health in the Processing of Vinylchloride

Participants

Dr. W. Ernst, Professional Cooperative Society of the Chemical
Industry

Dr. W. Freiesleben, Wacker Chemie Company, Ltd., Munich

H.-P. Friedel, Professional Cooperative Society of the Chemical
Industry

Dr. H. Goermar, Dynamit Nobel Company, Inc., Troisdorf

Dr. H. Kotzschmar, Plant Doctor at the Hoechst Company, Inc.,
Gendorf

Dr. A. Schuetz, Dust Research Institute of the Main Association
of the Industrial Cooperative Societies

Dr. H. Weber, Branch of the Public Factory Doctor for the
Nordrhein Inspection District

Concluding Address

Dr. H. A. Bischoff, Professional Cooperative Society of the Chemical
Industry

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With regard to the MAK (Maximum Working Site Concentration) values, the following level in a few of the countries represented in the Conseil European des Federation de l'Industries Chimique may be of interest:

USA	1 ppm; for 5 ^{ppm} minutes it may be exceeded up to 15 ppm ^{minutes}
Belgium	As in France
Germany	At the present time, no MAK value; after June 1, 1975, the following TRK (= Technical Guide Concentration) values: for new installations: 5 ppm as an annual average value; for the period of an hour, the concentration may not be exceeded by an average value of 15 ppm; for existing installations: 10 ppm; for existing installations as a transitional regulation until July 1, 1976: 20 ppm
England	25 ppm (may be exceeded up to 50 ppm for 15 min)
Finland	5 ppm (after March 1, 1975)
France	25 ppm (expected for 1975)
Holland	10 ppm (standard)
Italy	50 ppm
Japan	25 ppm (or lower)
Canada	10 ppm (may be exceeded up to 25 ppm)
Norway	as in the USA
Sweden	as in the USA

2. Round Table Discussion on Measures for Avoiding Effects Adverse to Health in the Processing of Vinylchloride.

Dr. Schuetz

Ladies and Gentlemen,

In the first part of today's informatory conference, the medical problems connected with working with VC have been discussed. The second part, which is intended here as a round table discussion, now deals with the protective measures to avoid effects adverse to health. We will address ourselves thereby to the problems involved both in technical as well as medical protection. The form of a round table discussion has been deliberately chosen here so that, after brief introductory reports by the gentlemen present here, we can move as soon as possible to a discussion among the speakers and with you.

Allow me to say a few words right at the beginning. As with all working substances which are dangerous to one's health and which in the forms of dusts and gases can have an effect on the health of humans, there exist also in the case of vinylchloride, with respect to its nature, very different measures to protect employees from illnesses. As so-called primary protective measures, I would consider those measures in which it would already be possible to reduce the occurrence of VC with the procedures and apparatuses used so that there would no longer be a risk for the persons exposed. If this would succeed, that would be a great gain.

As secondary protective measures, I would consider those measures which one commonly designates as protective measures in connection with dusts and gases, i.e. such examples as the suctioning off of harmful substances, airing measures and of course, personal breathing protection. In addition to these primary and secondary measures, there are the so-called organizational measures within the plant, i.e. the management of labor, in order to reduce the length of exposure of employees to a minimum. And finally,

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supervision also belongs to the entire complex of "protective measures"; this means both measurement supervision in order to determine what the situation with respect to the injurious substance is really like, as well as the work-medicine supervision on the basis of the precautionary work-medicine examinations such as a screening test and subsequent tests. The composition of the panel here reflects the complexity of the problems involved.

In his introduction Mr. Schroeder has already presented each gentleman. There are three gentlemen here who represent technology or the technological side of the protective measures and three, who represent the medical or the work-medical side. The discussion will be started by allowing the gentlemen here to give a summary representation of current problems in the form of a brief introductory report from their field of expertise; each report will be about 5 minutes long. Subsequently, the panel will carry on a discussion concerning any unanswered questions and then the discussion will be carried over into the audience. You may ask questions concerning the topics discussed here as well as questions with regard to the lectures in Part 1. May I ask that in the discussion you make use of the microphones set up in the hall and that you give your name and institution each time as the discussion will be taped.

May I ask the gentlemen at the table to try to use understandable terms in presenting the problems involved since not everyone is in the same field of study.

Dr. Ernst

Measures for Protection Against Effects Adverse to Health in the Processing of Vinylchloride

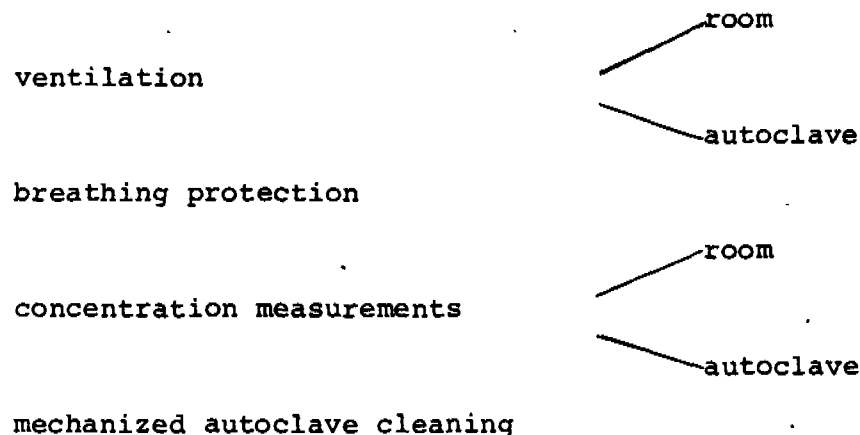
I would like to report briefly on measures to avoid effects adverse to health in the processing of vinylchloride as they are seen by the Professional Cooperative Society. After VC illnesses became known, the question as to the cause was the first one to arise. Since the reported cases of illness appeared in clusters, it was obvious that investigations should be conducted with the purpose of determining whether there were procedural differences in the plants producing the PVC. A categorization of the cases of illnesses into one of the 3 common production processes for PVC emulsion, suspension or mass polymerization, however, was not possible. The next thing to be tested was whether in addition to the vinylchloride itself, the impurities contained in traces in the vinylchloride or the potential reaction products of the auxiliary substances used could have an influence. The analyses of the pure vinylchloride used and of the vinylchloride regained after the polymerization -- of the so-called retro-VC -- from various PVC producers were evaluated and compared. Generally, the sum of all admixtures in the pure-VC $\leq 0.01\%$ by volume and in the retro-VC $\leq 0.01\%$ by volume. There was no indication of a suspicious or extraordinary compound. A significant difference between the vinylchloride produced from ethylene and the one produced from acetylene could not be detected. The monomer vinylchloride itself remained as a cause for the so-called vinylchloride illness although until the conclusion of the scientific investigations within the framework of the research contracts and in plants also, the participation of a substance which had not been recognized up to now should not be completely discounted. The investigations on the part of the Professional Cooperative Society now concentrated on the question whether there were different conditions at the working sites of the various plants and at which places there existed focal points

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of endangerment to health through the effect of vinylchloride. Connected with this there was an evaluation of the safety measures already present, especially in those plants in which no illnesses had occurred. As a result of these investigations, in which I participated, having been specially commissioned by the Professional Cooperative Society to work together with the Technical Supervision Officials responsible for the individual plants, definite safety demands could be made by the Professional Cooperative Society. Upon carrying out these demands, an extensive reduction of the vinylchloride concentration at a working site should be possible.

In the "Guidelines for Protective Measures Against Effects Adverse to Health in Dealing with Vinylchloride," which were published by the Professional Cooperative Society in April 1974 in cooperation with the plants and governmental authorities, these measures for the attainment of the desired safety level are fixed. You can see a compilation of the safety measures in this figure, which is now over a year old.

Safety Measures



Dr. Ernst	Vinylchloride Guidelines	2
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Today, one must proceed from the fact that these measures are the absolute prerequisite for an extensive reduction of a health hazard at a working site. The ventilation is of primary importance, whereby both the production rooms as well as the interior of the autoclave have to be considered. Then protection for breathing, in case the limiting value for vinylchloride is exceeded. Furthermore, the effectiveness of the ventilation measures must be checked by concentration measurements using suitable procedures and finally, one should strive for a mechanized autoclave cleaning, for example, through the use of hydraulic cleaning devices in order to reduce extensively the length of time employees must stay in the autoclave.

After mechanized cleaning did not appear possible in the case of the mass polymerization process according to the present level of technology, a limitation of the inspection time was demanded. In this connection, it should be mentioned that the general operating conditions are also of significance. One can give as an example that older and smaller autoclaves, as a rule, require higher maintenance and repair costs in relation to the unit of PVC produced. The number of armatures, conduits, etc. to be assigned to an autoclave also increases the number of possible leaking places for the vinylchloride so that with a transition to larger production units, more favorable conditions can be created.

With the measures which were briefly described here, the desired safety level was to be attained in all plants, whereby after a transitional stage the goals with regard to the vinylchloride concentrations to be maintained at a working site were to be determined.

In the guidelines, reference was made to the MAK value of 100 ppm, which was valid at the time. A change was made in June 1974 with the result that a limiting value of 50 ppm was not to be exceeded. This was in connection with the suspension of the MAK value for vinylchloride with the appearance of the MAK value list 1974, in which vinylchloride was put into the group of working materials which cause cancer. In order to give support for the measures to be taken and the measurement supervision at a working site, a

Technical Guide Concentration (= TRK) was set up by the Committee for Dangerous Working Materials at the BMA with the cooperation of the Professional Cooperative Society as well as representatives from industry.

This TRK value is valid from July 1, 1975 on. It is important that the TRK value be understood as an average annual value and that for a period of one hour, the concentration as an average value may not exceed three times the TRK value. The amount of the value is generally 5 ppm, subject to the proviso that for existing installations for the production of PVC, a value of 10 ppm was fixed and in addition, a value of 20 ppm is allowed as a transitional regulation for these installations up to July 1, 1976.

In conclusion to my brief introduction to the discussion concerning measures for the prevention of effects adverse to health in the processing of vinylchloride, I would like to make reference to the processing of PVC with one statement. In order to be on the safe side and to eliminate a possible health hazard, the desirable goal for further processing is VC or monomer-free PVC.

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Dr. Freiesleben

Measures in PVC Plants Against the VC Hazard

Ladies and Gentlemen,

The PVC industry was taken by surprise by the new physiological properties of vinylchloride described today. However, within a short time we were able to take measures or to introduce them in order to counter the hazard which had suddenly appeared.

These measures can be divided into five groups:

- measures in the management of the plant
- changes in conducting the air
- changes in apparatuses and facilities
- new types of technology
- analytical measures

All changes in the organization of the way the work is done and which have the goal of lowering individual VC exposure of the plant personnel belong to the first category: for example, doing away with the autoclave cleaning crew, avoiding practices in the so complex and irregular manipulation of the predominantly discontinuous PVC processes which contributed to raising the VC concentrations in the air in the plant, such as insufficient suctioning off or airing before the opening of autoclaves, containers or conduits carrying VC. In this category belong also the necessary instructions to the crew to watch out for leakages, in general to be especially carefully in dealing with VC, to avoid untidiness, and in plant operations to avoid every - including the very slightest - streaming out of VC at any point into the atmosphere of the plant.

In the second category "measures in conducting the air," there belong, first of all, any changes in the ventilation of the plant or of the plant building. The VC concentration in the air of the plant can be lowered considerably by appropriate multiple

air exchange. Furthermore, in this category belong all measures to provide those places in the plant where VC could reach room air with special suctioning off devices or to seal them off or cover them up and to bring any VC emission which might be unavoidable under appropriate control: for example, to cover up waste water canals -- which ran through the plant mostly as open conduits covered only with screens -- and have supervised ventilation; to wall off or caulk compressors with axles which are not leakproof; to cover up screen cases, cap off points on apparatuses where leakage is especially possible, and to provide special suctioning off, etc. Finally, in this category there belongs personal breathing protection when working in unavoidably higher VC concentrations, e.g. during plant disturbances, gas outbreaks, etc.

Changes in apparatuses and plant facilities include not only sealing off stirring axles and exchanging valves, armature, pumps or compressors for parts with a greater degree of imperviousness or plant safety -- the originally used facilities were in conformity with the plant safety requirements of the time -- but also, all devices for the mechanization of all work carried out manually up to now, e.g. cleaning the autoclave. In this area, the PVC industry has already done a lot in order to reduce decisively the concentrations of VC in the room air.

Among the new types of technology, we can enumerate all the measures and developments which have been started in order to attain controlled circulation, i.e. to arrive at a strict maintenance of required material balances everywhere that vinylchloride was formerly given off into the surroundings, e.g. the waste air from the drier also, to use methods for the degassing of the VC recovery or absorption in such a way that all emissions of vinylchloride can be maintained under control at certain limiting values. In addition, this includes any measures which lead to smaller residue monomer contents in the types produced. The investments which have been made up to now and the planned costs for these facilities and types of technology are considerable.

Finally, all measures would remain qualitative if there were not a simultaneous development and setting up of the appropriate analytical methods in order to follow the VC concentrations in the plants with measurement data.

This is true not only for a stationary analysis which constantly checks the air in the plant and reports any overstepping of the concentration limits -- it includes the equipment, e.g. locks with portable gas detecting devices for leaks and examination of the personnel for exposure; Herr Dr. Goermar will report on this analysis.

Dr. Goermar

Measures to Avoid Effects Adverse to Health in the Processing of Vinylchloride -- Measurement and Analytical Possibilities

The given limiting value for the concentration is only as good as its maintenance through measurement checks.

Therefore, the processors of vinylchloride (VC) have installed extensive analysis measurement systems which measure the concentration of VC in the room air. The measurement difficulties which confront one of the introduction of such supervision systems are the result of the following problems:

1. Very low concentrations have to be measured (1 ppm has to be recognized by the analysis instrument), ($1 \text{ ppm} = 10^{-6}$ volume parts).
2. Many analysis procedures have transverse sensitivities toward other gaseous impurities of the air, i.e. they also indicate these.
3. As a rule, there is a regulation for protection from explosions for the rooms to be supervised; this greatly limits the possibilities for using analysis measurement instruments.

The problems have been solved in the last few years to the extent that today for almost all tasks of VC measurement technology, suitable instruments are available. In essence, one can distinguish three measurement systems:

1. Stationary Systems

From fixed measuring points, measurement gas is sucked in, led to an analyzer and the analysis values are continuously registered.

2. Portable Analysis Instruments

They are predominantly used in the search for leaks. Their use is only conditionally possible since, up to now, no instrument is explosion-proof.

3. Personal Dosimeter

They are carried by the individual employees on their bodies and can determine the mean concentration which the carrier has been exposed to during the measuring time.

Personal dosimeters are hardly used in the Federal Republic of West Germany since up to now there does not exist an instrument in an explosion-proof model. Also from a purely measurement-technological standpoint, their use is problematical.

With the stationary systems and the portable measuring devices together, one can obtain a good overview of the VC situation in working areas.

Today, there are essentially three measurement procedures used with analysis instruments. First, there is the flame ionization detection, which has the advantage of measuring quickly and continuously but the disadvantage of not measuring VC-specifically. Secondly, the gas chromatograph, which has the advantage of measuring VC-specifically, but the disadvantage of not measuring continuously. For the present problem today, cycle times in the gas chromatographs must be set between 1 and 3 min. Thirdly, there is an electrochemical process which measures continuously, but is not completely VC-specific and has the disadvantage of being affected by a long time constant.

As one can see, there is no "patent recipe" for a plant analysis measurement system for vinylchloride; rather, one must choose the measurement system with regard to the specific plant conditions.

Friedel

Report on the Research Projects Introduced in the Federal Republic
of West Germany in Connection with the So-called Vinylchloride
Illness

We were all greatly taken aback, ladies and gentlemen, when it turned out that a material which for years had been regarded as relatively unobjectionable was capable of causing such grave aspects of a disease as the type previously mentioned. In addition to the measures immediately introduced at the working site for technical protection and medical prevention, research projects were commissioned by various parties to give us information concerning the real cause of the illness; from this we hope that our knowledge will be extended beyond vinylchloride to include other injurious substances. We would gladly give a detailed report on each of the individual research projects. Since this is not possible in the brief time available, I will limit myself to giving the information in key words. In each case the party commissioning the research and the group doing the research will be mentioned and an attempt will be made to outline briefly the research goal.

1.1 Bundesministerium fuer Arbeit und Sozialordnung

Zentralinstitut fuer Arbeitsmedizin, Hamburg
(Prof. Dr. med. Lehnert)

Gathering of literature and critical evaluation

Here a two-stage procedure was intended. First, the available literature was to be collected and subjected to a critical review and secondly, analytical investigations were to be carried out on autoclave air and retro-VC. The Hamburg institute first of all devoted itself to the task mentioned first and at the beginning of March of this year had already collected 530 relevant titles, of which in 420 cases the original papers could be procured. After

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a critical review and description with the aid of 120 especially chosen key words, the Hamburg institute is able today to make available quickly literature on special questions of the so-called vinylchloride illness.

1.2 Land Nordrehin-Westfalen

Dienststelle des Staatlichen Gewerbearztes,
Aufsichtsbezirk Nordrhein, Duesseldorf
(Ltd. RGMD Dr. med. Reinl)

Epidemiological Investigations

This broadly laid-out research project comprises cases of death and illness of employees exposed to vinylchloride. The basis material required for this was made available by doctors from the PVC-producing plants. Up to now, about 80,000 index files have been evaluated. The death cause was thereby determined in the case of 225 employees who were exposed to vinylchloride for at least one year. In view of the hemangiosarcoma of the liver, special attention will be given to those cases in which cancer was the cause of death. In a plant which produces and processes PVC, but also has other production branches, all registered death cases since 1945 were investigated and steps taken to procure the approximately 2,000 death certificates. Through their evaluation it is hoped that one can cross-check between the groups of persons who were exposed and those who were not.

1.3 Berufsgenossenschaft der chemischen Industrie

Institut fuer Pharmakologie und Toxikologie der Universitaet
Wuerzburg
(Prof. Dr. med. Henschler)

1.3.1 Pharmacokinetics and metabolism of vinylchloride ($\text{CH}_2 = \text{CHCl}$)

1.3.2 Pharmacokinetics and metabolism of vinylchloride ($\text{CH}_2 = \text{CCl}_2$)

It is not yet certain whether the vinylchloride itself or technical impurities or even conversion products -- possibly formed only when they are absorbed into the organism -- are responsible for the effect which causes cancer. Furthermore, the quantity relations between effective concentration, time length of the influence and extent of the carcinogenesis effect have not yet been determined. An important key for the clarification of these questions is given by the knowledge of the pharmacokinetic behavior of vinylchloride and of the reactive metabolites formed in the organism. In the spring of 1974 the Wuerzburg institute was commissioned with the clarification of these questions. In the first research stage there, the intake and metabolizing rate of VC was tested on isolated perfused rat livers. It was determined that up to 500 ppm -- practically independent of the concentration -- the metabolism rate amounts to about 15%. As a metabolite, the monochloric acetic acid was qualitatively and quantitatively determined. Particular attention will be devoted in Wuerzburg to an observed peroxide formation.

In a second stage, which started in the spring of this year, inhalation experiments with radioactively marked vinylchloride are being carried out; these are carried out through short-term inhalation of various concentrations, which lasts for several hours and is repeated for several days. In this connection the storage in and liberation from fatty tissue with respect to the extent and duration of the inhalation will be tested; this aspect is very important for a practical evaluation.

In metabolism processes the vinylchloride is not only activated to reactive metabolites, but there are also mechanisms which once again inactivate these products. A question of special interest therefore is whether one can determine external conditions which make these inactivation mechanisms ineffective and therefore prepare the path to illness.

Observations here and abroad have brought up the suspicion that in addition to vinylchloride there are other, similarly structured compounds which are able to cause illnesses. Therefore, in

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the spring of 1975 an additional, similar research project was assigned to the Wuerzburg institute, which should give information concerning the pharmacokinetics, metabolism and toxicity in acute and chronic exposure to vinylidene chloride.

1.4 Berufsgenossenschaft der chemischen Industrie

Werkaerztliche Abteilung der BASF AG

(Prof. Dr. med. Thiess / Frau Dipl.-Biol. Fleig)

Chromosome investigations after exposure to VC

It is known that some noxious substances -- especially from alkylizing compounds -- not only cause cancer but can also produce chromosome deviations, i.e. they are able to change genetic material in a negative manner. In view of the occurrence of hemangiosarcoma of the liver -- a very rare type of liver cancer -- the obvious thing to do was to check whether a correlation between mutagenicity and carcinogenicity could also be determined for vinylchloride. The Professional Cooperative Society of the Chemical Industry therefore gave financial support to chromosome investigations after VC exposure, which are being carried out by Frau Dipl.-Biol. Fleig at the medical division of the BASF AG. The first results available have brought no indication as to a mutagenic effect from vinylchloride.

1.5 Verband der kunststofferzeugenden Industrie

Niederlaendisches Zentralinstitut fuer Ernaehrungsforschung

Reports of the content of monomer vinylchloride in alcoholic substances which had been stored in PVC flasks provided a reason for testing the oral toxicity of vinylchloride. At an informatory meeting, Herr Dr. med. Weigan from the division of factory toxicology of the Hoechst AG gave a report on feeding experiments which were carried out with the financial support of the Verband der kunststofferzeugenden Industrie in the Niederlaendisches

Zentralinstitut fuer Ernaehrungsforschung. In several experimental series, vinylchloride in sesame oil was applied to rats with a stomach tube or for several years they were given PVC-containing feed, which contained defined quantities of monomer vinylchloride. One arrived at the result that the "no effect level" in the intake through the stomach-intestine tract lies at 30 mg VC/kg rat. This means that the oral toxicity of vinylchloride is less than when it is inhaled. It will take more time to be able to make any statements concerning the cancer-causing effect of vinylchloride in the feeding experiments.

The cooperation between the state, the Professional Cooperative Society and industry which has taken place in connection with the research projects described above may be described as good. We all hope, ladies and gentlemen, that the results of this research together with the measures for technical and medical protection which have already been taken at the working site will hinder any new occurrences of illness due to vinylchloride.

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Policy of the Professional Cooperative Society for Precautionary Medical Investigations in the Case of Health Hazards due to Vinylchloride

In order to be certain that employees endangered through exposure to vinylchloride received a uniform precautionary medical investigation and an evaluation according to the same standards, the work-medical commission of experts of the Professional Cooperative Society of the Chemical Industry framed working instructions for the plant doctors of the PVC-producing industry. Then, using documents from the Government Factory Doctor in Duesseldorf as a basis, plant doctors, scientists and Government Factory Doctors worked out a policy for precautionary medical investigations. A new draft is available for you today -- March 1975.

This policy requires that before assuming a job at working sites endangered by vinylchloride, a screening test be taken and that during this activity, control tests be made at intervals of 6-12 months. The policy names those investigation methods which are regarded as necessary and those which are desired and gives information concerning medical criteria which if present in the person concerned make him unsuitable for work in VC plants. In addition to supplementary suggestions, there are instructions from the Government Factory Doctor in Duesseldorf, whereby medical assistants will make a uniform counting of thrombocytes -- a particularly important medical parameter; this will make possible comparable results for all those exposed to vinylchloride.

We hope that with this policy -- which has its parallel in 30 other regulations for noxious substances and hazardous activities -- we have created an instrument which guarantees uniform medical care for all those persons exposed to vinylchloride.

Dr. Kotzschmar

Measures to Prevent Effects Adverse to Health in the Processing of Vinylchloride from the View of the Factory Doctor

You have already received detailed information concerning those illness aspects which have become known up to now in persons who have had frequent contact with high concentration of VC.

We plant doctors can prevent these effects adverse to health in the processing of vinylchloride only by carrying out systematic precautionary investigations in order not to let endangered persons even come into contact with VC or to transfer persons with changes which could favor the formation of typical symptoms to other working sites in time.

In order to be able to carry out this task effectively, a policy for precautionary investigations in the case of a health hazard due to vinylchloride was worked out in cooperation with the Professional Cooperative Society of the Chemical Industry. Allow me to explain these regulations and the consequences which thereby arise for medical practice at a plant.

In order to make sure that human beings who have health weaknesses should not even be exposed to a hazard from chemical substances, it is important that a screening test be demanded before assuming a job at a VC-processing plant. Thus, workers with blood diseases, sclerodermiatype and other serious skin diseases, acroosteolysis, disturbances of the nervous system, vascular changes (especially blood supply disturbances of the fingers) and liver ailments which occurred in the last two years or are still present may not be employed in the VC area. The reason why persons who are very overweight may not work there is the following: body fat is stored not only in the visible places such as the belly, arms or legs, but also in the inner organs, in particular, the liver. This leads to fatty degeneration of the liver and therefore, frequently, to pathological conditions. Since we now know that there can be harm to the liver during the processing of VC,

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we will as far as possible prevent the use of very overweight persons in VC plants. The same is true for people who imbibe more alcohol than is normal. Alcohol is quite simply the liver's main enemy, and a large portion of the liver ailments attributed to the VC are probably caused by alcohol. Therefore, the doctor at a plant cannot justify allowing persons addicted to alcohol to be hired at VC plants. The situation is similar in the case of people who continuously take medication which harms the metabolism of the liver. This is also not compatible with contact with VC.

The reason why we are reluctant to place persons who misuse nicotine in a VC area is that nicotine is a vascular toxin. You are familiar with the term "smoker's leg" when there are strong blood supply disturbances in the legs. In the same way, blood vessel constrictions may appear in the hands and fingers, which we now also find in the so-called VC illness.

In control tests as well as with the screening test, the plant doctor relies on a well equipped laboratory and an X-ray machine. With the aid of an X-ray picture we can very probably recognize or eliminate changes in finger bones. The plant doctor is thereby able to diagnose acroosteolysis. In order to be able to recognize blood supply disturbances in the fingers early enough we carry out a cold test, whereby the person must hold his hands in water which is colder than 15°C for 5 minutes. If the fingers begin to ache or if they remain pale for a longer period of time after having been exposed to cold, then this could be an indication of a vascular disturbance. With special laboratory methods, a precise examination of the urine is carried out, whereby in addition to protein and sugar, the urine must be checked in particular for the presence of bilirubin. These occur in increased amounts in the case of liver ailments. Hypostasis is indispensable and a blood picture must be made. Among other things, conclusions may be drawn with this concerning certain changes in the body such as inflammations or anemia. It is evident that blood platelets must be counted in order to exclude the so-called thromocytopenia. The carrying out of certain liver tests has a very special significance .

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With their aid it is often possible to diagnose typical liver changes, which could be the beginning for other, more extensive investigations.

It should be mentioned here that we doctors have to question our co-workers about typical complaints. One should pay special attention to a feeling of fullness, pressure in the upper abdomen, stomach-intestine disturbances, the loss of weight of appetite. This can give us valuable indications of the presence of a liver ailment or even of a tumor. One of the duties of a doctor is also to determine changes of the liver and spleen with regard to size or consistency, which can be done by feeling the body with your hand. A trained person can use this method which does not require any great expense in order to obtain information about certain illness processes.

If the doctor has determined conditions which deviate from the norm and these continue after a control test, then he should send the co-workers concerned to a clinic in order to obtain a more extensive diagnostic clarification. There it is possible to find out the causes of the symptoms with costly investigations such as liver puncture, liver and spleen reflection, X-ray examination of the esophagus or liver scintigraphy, or by means of a complicated investigation using radioactively marked substances. There, one must also decide whether the pathological changes initially observed are the result of a contact with VC or the expression of another pathological occurrence.

Of course, it is the duty of the plant doctor not to let a co-worker be active in the processing of VC any longer if he is of the opinion that the pathological findings which appeared in the control test might be caused by contact with VC or if they can be worsened by continued contact.

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Schuetz thanks the panel experts and opens the general discussion.

Freiesleben asks Weber whether there is reason to believe that there is a health hazard with low VC concentrations.

Weber answers that in recent times low VC concentrations, of about 1 ppm have been measured in the processing; however, one is not certain whether the values were not higher formerly. Prof. Dr. Lelbach attributes characteristic liver fibrosis to the effect of VC in the processing of PVC. There is still no proof whether in fact a correlation exists between liver fibrosis and exposure to VC in the processing.

Freiesleben points out the frequency of the Banti syndrome in Japan, India and Africa. Certainly, there was no effect from VC there; nevertheless, the disease is very similar.

Mappes is of the opinion that it is of interest whether fresh or stored PVC powder is used in processing since the residue VC content quickly declines during storage.

Hauss asks to what extent investigations on persons not exposed to VC have been made or are planned. Only after the results of such investigations are available can one say whether this or that individual symptom is specific for VC or not.

Schuetz points to the expected consequences which one must reckon with if the suspicion of adverse effects to health through low VC concentrations is verified. If one is now confronted with about 3000 employees in the production of VC/PVC, then one must reckon with a multiple of this number in the processing of PVC.

Besche goes more into detail concerning the 6 cases from PVC processing mentioned by Prof. Dr. Lelbach and reports that 2 of the 6 sick persons never were exposed to VC although they had the same symptoms (fibrous capsule). In the past year, the other 4 persons had been exposed to VC concentrations of less than 1 ppm.

Friedl addresses himself to the three cases in the area of the Bezirksverwaltung Nuernberg, which were mentioned by Dr. Versen. These cases are not significant and it must be doubted whether in fact one is dealing with a so-called vinylchloride illness. In one

case breathing disorders are mentioned, whereby one is apparently dealing with silicotic changes of the lungs. In a second case, there are complaints of a cold and throat irritation, and PVC dust -- not the monomer VC -- is blamed.

Schneider asks that we reflect upon the fact that in the processing, VC cannot be formed through the decomposition of PVC. The VC measured in the room air could only stem as residue - VC from the PVC powder. In this one would have to consider in particular whether PVC is processed as a powder, granulated matter or a semi-finished product. Granulated PVC matter and semi-finished products contained VC only in the order of magnitude of 1 ppm.

Wolff recommends checking the characteristic liver conditions observed by Herrn Prof. Dr. Lebach in the persons from PVC processing. The question whether low VC concentrations could cause the described illness would require more thorough investigations; this is also true with regard to the Banti syndrome mentioned by Freiesleben.

Freiesleben reflects upon the fact that in the PVC-producing plants of the world there are perhaps 20,000 to 30,000 employees; in the area of processing, on the other hand, there are several hundred thousand, if not a million. If the cause for the so-called vinylchloride illness is seen in VC concentrations around 1 ppm, would one not have to reckon with an epidemic?

Thiess explains that only cases from PVC processing have been observed in Germany up to now. Abroad he has been repeatedly asked about these cases; therefore he requests that the Professional Cooperative Society give preference to an investigation of these cases and that it be determined in each individual case whether there was any exposure to VC.

Gaeth is of the opinion that one can decide whether or not there is a VC illness only if various illness symptoms appear in large amounts as opposed to a larger group which has not been exposed to VC. It is generally common to draw scientific conclusions only if the comparison with a suitable check lot is possible. Since this is apparently not possible at the present time, one has to

distinguish between scientific certainty and expressed suspicion. One has adapted to the available knowledge with measures for technical and medical protection at the working site and this has been greeted by all parties. On the other hand, if the basis is mere supposition one must warn against demanding measures which exceed that which is necessary and technically attainable and which would lead to unjustifiable financial burdens for the economy.

Schneider asks whether there are foreign employees from certain countries who are particularly susceptible to the so-called vinylchloride illness. In the flooring plant of the Dynamit Nobel AG, which is directed by him and which has been often cited, 26 suspected cases have occurred. There was 1 Turk, 2 Germans and 23 Greeks; as opposed to this, there are only 32% Greeks but 45% Germans in the plant.

Concerning the first part of the conference, Eichhorn has the impression of a festive academic meeting which concerns itself with great problems, which doubtlessly also exist. However, he would like above all to have explained which other measures will have to be taken in the future for the protection of employees in the processing of VC/PVC. Careless handling of VC by employees certainly has its origin also in the attitude of the management toward safety at work. Here something still had to be done since safety at work did not begin with the employee but with the management. Employees would have to be given clear information concerning the hazards and safety measures and they would have to be given the feeling that the professional cooperative societies, the management and trade unions together with those responsible for factory inspection were doing everything to safeguard the health of the individual now and in the future. In this connection, it is to be lamented that events concerning VC illnesses were kept secret by some firms.

Weinmann would like to know how advanced the development of VC-free PVC is and which group of persons in the processing of PVC would be involved in precautionary investigations.

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Ernst reports that in the reduction of the content of VC in PVC, considerable progress has already been made. The ideal value of zero had not yet been reached and would not be reached either in the near future. The content of VC depends above all on the process by which the PVC is produced. Whereas in the case of emulsion-PVC values have already been reduced to 20 ppm by weight, the VC content in the cases of suspension-PVC and mass-PVC is presently at 100 to 300 ppm -- in contrast to former times when one was dealing with orders of magnitude of 1,000 to 5,000 ppm.

Freiesleben adds that most emulsion-PVC types contain less than 10 ppm and that one expects a reduction of the VC content in suspension-PVC to less than 100 ppm in the course of this year, at the latest, however, in the first half of next year. In carrying out the necessary measures, one is frequently dependent on delivery dates of apparatuses, etc.

Friedel discusses the question asked by Weinmann concerning the limitation of the group of persons to be examined. With regard to the scope, from the very beginning account was taken of PVC processing in Point 1 of the vinylchloride regulations. The areas in which a health hazard exists through emission of monomer vinylchloride from the intermediary or finished products were named. With this information one also has a basis for carrying out the precautionary medical investigations demanded in Point 6 in the area of processing. At the present time, one is not of the opinion that in the areas mentioned there is a health hazard comparable to the production of VC/PVC. Therefore, precedence is given to medical precautions in the areas in which the so-called vinylchloride illness has in fact appeared. This occurs in the first place with the intention of giving the medical potential to those workers whose health is actually endangered. Concentration on the area of the production of VC/PVC should be regarded as the expression of a priority and does not mean that the problem of the processing industry is not being carefully watched.

Schuetz discusses the previous explanations and determines first of all that it is not certain whether a correlation exists

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between low VC concentrations in PVC processing and the observed illnesses and secondly, that it is important to lower the residue VC content in PVC decisively in order to reduce the number of those possibly endangered to a manageable number. Finally, Schuetz turns to Weber with the request that he say something concerning the topic "suspicion or certainty."

Weber confirms that up to now there is no scientific proof for the correlation between the previously observed individual symptoms and an exposure to VC. Since on the other hand, there is no proof that low VC concentrations are not dangers, all possible protective measures, both technical as well as personal, which are justifiable should be taken. He also considers it important that workers be made aware of the fact that possibly even small concentrations could be dangerous.

With reference to the key word "secrecy," which was mentioned by Eichhorn, Freiesleben denies the charge which has been raised again and again that industry deliberately deceived the public with regard to VC and kept information secret. Already in the Sixties Wacker Chemie heard about acroosteolysis and could not determine any cases after examining its employees. In 1969 the firm heard for the first time about Dr. Viola's experimental results; Dr. Viola had found cancer in rats which had been exposed to 30,000 ppm VC. Subsequently, this result was discussed in Burghausen with the union steward. In Italy Prof. Maltoni continued the investigations with respect to cancer hazards; the results of his investigations which were available at the end of 1973 were made known to the public 4 weeks later. Freiesleben then goes into detail on what PVC-producing industry has attained in the meantime. In the oldest plants, it has been possible to a large extent to maintain the regulations in effect. With regard to costs which have been invested by industry for safety measures, Freiesleben gives an amount of DM 500 million. He believes that the problem can be overcome technologically unless surprising medical findings are made.

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Schuetz asks whether in spite of the technical measures carried out up to now, personal breathing protection is still necessary.

Freiesleben answers that in normal cases one can do without breathing protection. Nevertheless, there will always be situations where breathing protection is necessary.

Schuetz points out that the Maximum Working Site Concentration (= MAK) value for VC in the USA amounts to 1 ppm and would like to know whether with the present level of technology this value can be attained.

Freiesleben reports that many representatives of the American PVC producers are of the opinion that this goal can be attained through combined measures.

Reinhardt brings up once more the difficulties involved in the cleaning of the autoclave and thinks that if the discussion already revolves around low VC concentrations, one will not be able to do without personal breathing protection in the manual cleaning of the container because of the sudden occurrence of high VC concentrations.

Freiesleben reports that the technology of autoclave cleaning has improved considerably in the last two years; here, however, one would have to distinguish between the individual production processes.

Among other things, Schroeder explains that the VC problem does not exist alone and points to the slides showed by Dr. Versen, e.g. concerning the frequency of the various occupational diseases and the portion of occupational diseases in the total number of plant accidents. Furthermore, he makes mention of Gaeth's explanations and states that through a few cases of death in the VC or PVC area, the suspicion, which Gaeth addressed himself to, found its scientific justification. It was not the task of this forum to discuss whether the technical standards were too low or too high. Rather, one should discuss whether the measures taken up to now were insufficient or what else had to be done in order to protect the worker.

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Heimann stresses that today there certainly is not any employee in the VC- and PVC-producing industry who does not know what dangers this gas involves. Not carrying personal breathing protection, e.g. in changing valves, and the frequently observed, careless handling of VC was also due to the frequent lack of safety consciousness on the part of the worker.

Marcussen protests against these statements. He refers to the question of measurement technology, which is dealt with differently in different plants and recommends that the experience of one plant should be made available for the benefit of the others.

Goermar is of the opinion that one type of instrument cannot be recommended uniformly for all plants since the selection of the instruments conforms to the individual plant conditions which often vary. There are, for example, instruments which have a transverse sensitivity to other gases. If a plant must reckon with these foreign gases, then it cannot use such an instrument but must use another instrument which does not indicate these gases.

Wolf points out the main projects given out by the Professional Cooperative Society to determine VC concentrations at the working sites in PVC processing. There are difficulties in measuring the concentration range smaller than 1 ppm. Furthermore, it took a long time to compare the various processes with one another and then to pick out the best process.

Goermar distinguishes between the portable devices and the personal dosimeters. The portable devices are only conditionally useable for looking for leaks since these do not fulfill the conditions for being explosion-proof. According to his opinion, however, they could be used if the persons carrying the devices are correspondingly instructed and would withdraw from the danger area if the VC concentration rose to a dangerous amount. The situation is different in the case of the personal dosimeters. These cannot be used in West Germany because they are not available in an explosion-proof model and cannot be used as a warning instrument because they do not show the measurement value continuously. Because of this, they could not be used in explosion-endangered areas.

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Another disadvantage is found in the small endurance of the adsorption tubes. It ranges between 1-4 hours. Afterwards, each of the tubes must be exchanged. In addition to this, after July 1, 1975 the TRK value may not be exceeded by a multiple of three for the period of one hour. If one wants to check the maintenance of this regulation with a personal dosimeter, then the tube must be exchanged after every hour. Finally, in the long run the dosimeters are burdensome for the persons carrying the devices because of their great weight (500-1000 g).

Eichhorn stresses once again that with a positive attitude on the part of the management concerning safety at work and with corresponding measures in the plant, safety thinking will permeate down to the last man and then the previously mentioned incidents could vanish completely some day.

Kardaus asks about the practical destruction of the VC since otherwise protection at work can turn into an environmental problem. Furthermore, with unfavorable wind conditions the VC blown out of the plant through ventilation could once again enter the plant.

Concerning this, Freiesleben reports that the VC/PVC producing industry is trying to recover the liberated VC as much as possible and to eliminate the remainder through adsorption or combustion.

Kardaus asks whether values are thereby reached which lie under 0.3 mg per m^3 waste air.

Freiesleben answers that these values have not yet been attained in all plants.

Weber announces that the personal dosimeter will soon be obtainable in an explosion-proof model. He had brought back a device from the United States and encased it to such an extent that the TÜV (Technical Supervision Organization) had approved it. It was also not heavy.

Freiesleben points out that the Americans used the personal dosimeter only to check their measuring instruments which are installed in a fixed manner in the plants. The dosimeters are not suitable for determining which VC quantities have been breathed

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in by the workers since the breathing process is simulated poorly and in breathing VC-free air a part of the adsorbed VC is again desorbed from the tube.

Goermar points out the additional difficulty of supervising analysis in larger plants. It is extraordinarily expensive to use the personal dosimeters continuously in the plant in the case of a large number of employees.

Schultz asks whether there is a method with which one can determine the VC content in the blood.

Wolf answers this question in the affirmative and refers, for example, to gas chromatography. These and other methods also, however, are very expensive.

With regard to the dosimeters he admits that they would best work where an employee in a large plant has to work at various working sites.

Goermar adds that he is thinking less of the financial side of the analysis and more about the organization problem since the test tubes would have to be renewed hourly in the dosimeters. Otherwise, the measurement value would be falsified.

Friedel once again brings up the question about the determination of VC content in the blood and reports that he is not acquainted with measurements of this type. Even if the determination of the VC would be possible in measurement technology, it would be worthless at the present time inasmuch as one does not dispose of parameters which could give information concerning the medical significance of the values found. More interesting than the direct determination of VC would probably be the determination of its metabolites. Concerning this, however, one would have to wait first of all for the research results of the animal experiments which are being conducted at present.

Wessel asks whether the plant doctors had the possibility and sufficient time to supervise all employees in the particularly endangered plant sites according to the regulations for the precautionary medical investigations.

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Kotzschmar reports that in his plant in Gendorf, approximately 500 employees in the production of VC and PVC are supervised in accordance with the medical regulations.

Schuetz summarizes the result of the discussion and points to the need to research the effective mechanism of vinylchloride in the human body so that the question can be decided as to whether low concentrations of VC are dangerous to one's health or not. Furthermore, the important thing is to lower the residue VC-content in the PVC so that the number of VC-endangered persons can be maintained as small as possible.

With regard to measurement technology, in each individual case what will be important will be the system that is decided upon. Here, the conditions in the PVC-producing plants will be different from those in PVC-processing plants.

Schuetz expresses his thanks subsequently for the lively discussion and turns the floor over to Dr. Bischoff.

Concluding Words

Dr. Bischoff

Ladies and Gentlemen:

We have come to the end of our informative discussion. I have had to make some changes and expand the draft prepared for my concluding remarks.

What has been confirmed is that I may thank you for your active participation and your openly expressed views. My special thanks to the experts in the round table discussion as well as to all those who contributed to the success of the conference, including the discussion.

I hope that you agree with me in the view that this conversation has been useful for all participants even if a patent recipe could not be given for everything. Without the preliminary scientific work, there can be no completely adequate and practically effective protection. With regard to the necessary scientific groundwork, including the practical safety measures, the experts are to be thanked in view of the clear and open representation of their topics so that you, ladies and gentlemen, have received a comprehensive, factual picture as to where the problems of working safety with regard to vinylchloride now stand. The discussion has not only shown your interest in the problems but also brought up a number of individual questions, which should be of importance for further work, a task which should prove of benefit to the same degree to both safety at work and environmental protection.

I would be very happy if we all parted with the conviction of having worked together on a common goal, to safeguard and maintain the health of human beings at their working sites. An important factor in this common activity is the constant and open discussion with one another. If we always act in the spirit of today's conference, then our efforts will be rewarded with success. It is also important thereby not to make individual cases of faulty

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behavior of minorities on both sides -- employers and employees -- as the basis of an evaluation although our common efforts should be directed toward doing away with such faulty behavior; it is an unnecessary waste of health and money.

I also hope that it has become clear that our professional cooperative society is doing everything possible to eliminate dangers and risks for the people employed in our industry to the greatest imaginable extent given the good will of everyone and the best-possible use of the technical protection possibilities by all concerned. The difficulty in a quick and comprehensive solution of all problems lies above all in the fact that we have too little information from the past, which can give us accurate knowledge with regard to correlations. This makes our efforts in the near future all the more important, also with regard to the necessity of the determination and evaluation of the required medical data.

We ask you: help us in this work. Give us suggestions. Report to us on your future experiences and information. You may be certain that these facts will be immediately and conscientiously tested and made use of.

The board and management of the Chemie-BG would be glad, ladies and gentlemen, if you would take along from this informatory meeting, material and convictions to your plants, and if you take to your colleagues the certainty that there was a comprehensive and successful effort of all participants to obtain the safety of people working with VC and PVC.

I would also like to make a suggestion of a technical sort:

This was an internal informatory conference for the chemical field. Nevertheless, it should not remain half-obscure. The board of the Chemie-BG has provided for the publication of a press notice; this very evening it will be worked out by us with the participation of our joint management. By limiting ourselves to this joint press notice we would like to serve the factual purpose of our informatory conference. This press notice goes to the press agencies and to intrastate newspapers; it should also go to the

plants represented by you, ladies and gentlemen, to important regional newspapers and to factory newspapers. Please give Herrn. Dr. Kassebart or Herrn Dr. Schierwater the names of the regional newspapers.

This press notice will be sent to you, ladies and gentlemen, immediately; if you have not received it by the end of this week please remind us about it.

Furthermore, we are trying to bring out a comprehensive report concerning the informatory conference by mid-July, whereby I would like to assume the agreement of the experts and discussion participants but may also hope that they will help us without delay in the case of any vague points in completing the report.

Please report to us at the Chemie-BG, Hauptverwaltung, 6900 Heidelberg, Postfach 101480, by July 2, 1975 as to whether and how many copies of the report you would like to have sent to you.

Since some of us, among these Herr Schroeder and myself, still will be occupied with the text of the press notice, I will not be able to speak about all of us. Now, you, ladies and gentlemen, have done your duty today.

I would like to thank you once again for coming, for your participation and your patience. I will close our conference and wish you a good and safe return home.

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