



Norsk Hydro a.s,  
Porsgrunn Fabrikker,  
Norway.

Re: Production of PVC.

REPORT

0000377

by

The Medical Commission on the Production of PVC.

This report has two basic points:

1. We consider it an established fact that vinyl chloride can cause cancer in humans.
2. No human activity, job or habit is without some risk, and we should avoid setting up rules or opinions which would only serve to exchange one kind of hazard for another of possibly greater dimension.

From this standpoint we will examine whether the production of PVC can be undertaken with an element of risk which on the whole is no different from that which we encounter elsewhere in life, at work or otherwise.

The report concludes that PVC production can be carried out under conditions which satisfy this prerequisite. Supervision and safety measures which would make this activity no less hazardous than any other human activity would, at the same time, raise the price of PVC products.

The report deals strictly with the production of PVC from vinyl chloride. We have not been requested to examine production of further processing of PVC but are of the opinion that this can be undertaken without risk to health in connection with vinyl chloride, with the use of automation, good ventilation and appropriate storage time for PVC before further processing. The problems connected with the leakage of vinyl chloride in the production of PVC and with accidents during transport of vinyl chloride are discussed in a survey from the Environmental Protection Agency, Washington, D.C., September 1971.

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We consider it an established fact that vinyl chloride in up to 1000 PPM or perhaps greater concentrations, after several years can cause a very rare type of cancer of the liver in humans which probably would occur at the rate of one case per year in Norway or less. One case has been reported: A Norsk Hydro worker who for many years had been involved in PVC production. Although one cannot draw a conclusion from one isolated case, in the light of other cases reported in other countries, we must conclude that the production of PVC carried on by Norsk Hydro has contained an element of risk. However, for the average person this risk is very small. For example in Poland which has had and still has a considerable PVC production (and a good health service) there have been no reported cases of cancer of the liver among those who have worked in PVC production. Nor are there any cases reported in Japan.

We know very little about the risk connected with low concentrations of vinyl chloride in humans. Tests on animals which have been made can only give limited help in considering the same effects on humans. The results so far indicate a great difference in sensitivity between animals (mice, rats) and humans. We know therefore of no safe lower limit for humans. However, where a person's contact with a material known to cause cancer is concerned, the obvious conclusion is to avoid exposing oneself to such contact.

This point of view is based on a simple deduction. Human beings are composed of individual cells. These grow and renew themselves in such a way that they maintain the body's various parts and organs in equilibrium. This equilibrium can be disturbed, which among other things can be caused by certain chemicals and also by radiation. One theory for the cause of cancer claims that under unfortunate circumstances the cancer generating chemical can cause a cancer to develop

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from a simple change in an individual cell. It is therefore obvious that, for example, each and every x-ray contains a risk for cancer. The risk is, however, so small that we in practice take no other precaution than to avoid taking unnecessary x-rays.

Where vinyl chloride is concerned, observations would indicate that the danger lies in especially high concentrations for especially sensitive individuals with a special combination of vinyl chloride gas with some other chemical or with other special conditions with which we have no knowledge. However, there are no indications of any similar interaction with other chemicals used in PVC production.

We have noted that the reported cases of cancer of the liver are connected with certain of the factories which have produced polyvinyl chloride and that at other such factories which have been in business for a long time, no such cases have been reported. Even though it is possible to explain this away as a coincidence, one must also interpret it as indicative of the fact that the risk even with the high concentrations which have been common in industry until now, are not high. The published report on the mortality rate among those who have worked in the PVC industry in the USA would imply the same conclusion. Even though the data available is limited, there is good reason to note that the mortality rate among PVC workers is low and would indicate that those who have worked in PVC factories have no reason to fear an earlier death than others, -that on the contrary, the reported data indicates, that they have greater longevity than other. The reason for this is unknown.

A possible explanation for the observations which have been made so far could be that the body breaks down the vinyl chloride received in small amounts in a different way than it does the vinyl chloride it received in large quantities. Certain laboratory tests in the USA can be interpreted in this way.

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vinyl chloride received in large amounts which could be the cancer generating chemical (and therefore not vinyl chloride itself).

These observations seem to indicate that vinyl chloride is not necessarily a very active cancer generating chemical. However, we cannot deny the possibility that in the coming years new cases of cancer in PVC workers may be reported in Norway or elsewhere. There is no way in which we can prevent this. It is proven by experience that cancer can develop many years after exposure to a cancer generating chemical.

Researchers have been anxiously studying the possibilities of inherited genetic damage which is theoretically a possibility. However, no proof so far exists that any such genetic damage has been caused to the coming generation.

Although the commission does not find sufficient evidence to conclude that vinyl chloride is a specially active and dangerous cancer generating chemical, it would not however, wish to imply that there is no risk connected with this chemical. The quantity of vinyl chloride with which people come into contact ought to be reduced. The commission considers this to be technically possible.

PVC is produced when vinyl chloride gas with water and certain additional chemicals is heated and stirred while under pressure. The process is heat producing and must therefore be carefully controlled as there is danger of explosion. After a few hours, a mixture of water, vinyl chloride gas and PVC in small pebbles is produced. From this mixture, the water and unused gas are removed, then the PVC powder is dried out and colour can eventually be added as well as additional chemicals for further processing.

This process can be carried out in an enclosed autoclave (closed container under pressure), pipes, channels and

partly be carried out in areas where there are no people.

One should also ensure that as much as possible of the vinyl chloride gas which attaches itself to the PVC product is eliminated so that it does not spread any further.

This type of enclosed process must periodically be opened for routine cleaning and inspection of the autoclave. The opening of the autoclave should be done in such a way as to prevent the escape of vinyl chloride gas to the surrounding area (enclosed room, vent, autoclave vacuum).

When the cleaning of the autoclave is done manually, as it is in the present system, it can be carried out by workers wearing fresh air masks and protective clothing, thereby protecting them from exposure to vinyl chloride.

The procedure would be considerably simplified, from a safety standpoint, if the cleaning of the autoclave could be automated or if a process could be developed which would eliminate the need for cleaning. However, safety valves, drainage valves and such must in any case be cleaned and inspected. This implies that the equipment must be opened and the same safety measures taken as in the autoclave cleaning, i.e. workers wearing fresh air masks and no one must be admitted to the area until it has been aired out and is free of vinyl chloride. Similar precautions must be taken when there is danger of explosion or in any other irregular situation. Whenever fresh air masks are mentioned it should be understood that protective clothing and gloves are also indicated.

To check that this operation functions according to plan, an automatic measuring system should be set up for those areas where a leakage of vinyl chloride could occur. The measuring points should be determined by the

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normal situation arise. On the other hand, it is not necessary to supervise procedures which are known to have high concentrations (for ex. at the opening of the autoclave, because at such times protective wear should always be used), but it should be ascertained that the air is back to normal again after due ventilation. The fresh air inlet must also be checked.

Should a leakage occur in the system, it should be repaired in the same way as any other damage. To make a further check of any possible breakdown in the system, the workers should receive periodic checkups by the company's health department to ascertain whether they have been exposed to vinyl chloride, through for ex. the analysis of exhalations. Such a checkup should be made if at any time someone is thought to have been exposed to vinyl chloride, due to an irregularity in production. We consider this to be a better control method than the analysis of daily samples of the air which is inhaled in the course of the day.

The commission has chosen this solution for practical and technical reasons. After discussing the matter with technical experts we believe this method to be feasible. We consider it to be safer from a health standpoint and better than to operate with a threshold limit which cannot be justified toxicologically or medically.

From what has been said it is clear that the commission finds that the health hazard from exposure to vinyl chloride should be technically supervised. Therefore it would be natural that the environmental protection committee be assigned that responsibility of ascertaining that the amount of vinyl chloride leakage does not exceed the amount which inevitably escapes from an enclosed system. Even a so-called enclosed system is never entirely airtight. Some leakage occurs through gaskets and valves. The environmental protection committee can rest assured that the danger in production

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with supervised systems is so small that measures taken against health hazards in other areas of the factory would be better justified. The establishing of a threshold limit can give a false sense of security (because pollution, with simple means in certain areas, can be reduced to below the threshold limit) or an obstacle, because other tasks which safetywise are more important may have to be postponed.

With the reservation imposed by our limited technical and economical knowledge, we consider that a satisfactory process can be established at the present factory. However, this would require investing in safer production methods with consequently a probable reduction in output relative to working man-hours. On the other hand, it is our opinion that the situation can be further improved in a factory built along modern lines, and we can see no reason for Norsk Hydro to be satisfied with whatever improvements can be carried out in the present factory, but that they should as soon as possible, try to establish a factory where the most advanced technology can be implemented to avoid the exposure of workers to vinyl chloride.

Oslo, Dec. 16, 1974

Gudmund Harlem (s.) Tor Norsøth (s.) Terje Due Strand (s.)

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