Industrial Hygiene Control in the Manufacture of Pesticides

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INDUSTRIAL HYGIENE is a comparatively new field and, as such, deserves definition. Mainly, the work of industrial hygiene embraces a consideration of the total environment of people while at work from the standpoint of health maintenance. It has developed into a science through which it is possible to recognize, to evaluate, and then to control the potential factors in the industrial environment that are sources of occupational illness.

A major premise in this field is that the manufacturing, the handling, and the use of toxic substances can be conducted without the exposure likely to result in ill-health of industry's workmen. Engineering control of the workplace environment has now made possible the production of highly toxic compounds, while at the same time safe-guarding employee health. But this field has even broader aspects. In the past 20 years, the concern of industrial hygiene has also been with many other factors in the total work environment not necessarily classified as potentially serious health problems. These include the scientific approach to air pollution abatement because attention must be given not only to the well-being of plant people but, also, to the community in which the plant operates.

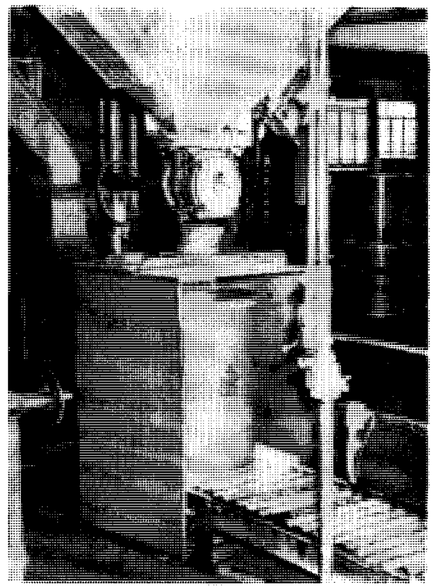
In the past five years, the attention of formulators of pesticides has been drawn to the activities of the industrial hygienist in maintaining desirable conditions of work for processing the more toxic substances. Not necessary today are those production methods in which industry's important asset, the employee, perform his work in a dusty atmosphere, is confronted with acid or alkaline mist, or is exposed to gases and vapors that might seriously affect his health.

During the past 20 years, the industrial hygienist has perfected techniques for the collection of air-borne substances. He has worked out chemical methods for trace analysis, determining quantities of contaminants accurately to one part per million and less. He has learned how to count dust particles in the size ranges below one micron in diameter. He has studied the toxicology of industrially used chemicals. With the knowledge of the source and quantity of industrial atmospheric contaminants, he has developed engineering methods for capturing, collecting, and preventing these substances from causing employee ill health. Generally, industry has found that a healthy employee at work in a healthful environment is an important factor in production.

Likewise important in the broad industrial health field are the toxicological studies that show whether chemical substances may be safely handled in manufacture and in use by the consumer, or whether it is necessary to apply protective environmental control measures. Without this phase of the work, it is safe to say that some useful and beneficial chemicals of economic agricultural importance would not be marketed today.

As a concrete example, let us consider how industrial hygiene has served in making available parathion, a highly toxic organic phosphate, for application as a pesticide. Early in research, it became evident that parathion possessed powerful and economically important insecticidal properties and, therefore, merited further investigation. In accordance with our company medical policy, the first toxicological studies of this substance began at the time parathion was available in only test tube quantities. The first reports of such studies were interpreted by the industrial hygiene section of our medical department in terms of those measures that were necessary for the protection of our research personnel. As more toxicity information became available, it was applied to the design of the prepilot and pilot stages of production. It was found necessary that our employees must be protected against inhalation and contact with the skin, not only against parathion itself, but also against certain raw materials and intermediate compounds used in its manufacture.

As plans were made for full scale plant production, the toxicological properties of parathion continued to be reviewed in terms of a safe working environment. The industrial hygienist developed techniques for atmospheric sampling and for trace chemical analysis, along with the design of employee protective measures.



An example of practical industrial hygiene: to eliminate the potential health hazard of dust in the drum filling operation, a hood enclosure is provided for control of the dust at its source

He worked as one member of a team that included the medical department together with research people, chemical engineers, production groups, sales groups, safety engineers, and others. As a team, they found it profitable to adopt these environmental control measures for protecting employee health, to specify operating procedures, and to establish a general philosophy with respect to toxic insecticide production. The information accumulated by this team was applied to the blueprints for new production facilities. With facts available, no game of trial and error need be played with a worker's health in the balance. This advance blueprint-stage planning for hazardous production paid dividends in employee good health.

Raw materials were emptied into reaction kettles through mechanically exhausted hooded enclosures about kettle manholes. Reaction products and intermediates were handled in closed systems properly vented to scrubbers. Local mechanical exhaust ventilation was applied at all points where equipment was opened for inspection, where sampling must be done and about pump packing

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glands, lest vapors escape into the breathing zone of operators. Centrifuges and filters were enclosed and exhausted, as was the final product drumming station. The process area of the building was isolated for this one production, and exhaust ventilation for the general area was installed.

Operators were provided with written instructions listing precautions to be observed at each step in production. These instructions were periodically reviewed as part of the employee training program to prevent exposure. In nonoperating areas of the building, separate shower and locker room facilities were installed. A separate lunchroom, independent from the plant cafeteria, was provided. Operators were furnished with freshly laundered white coveralls, underwear, socks, and cap each day. A separate laundry was provided within the operating building. Each operator received rubber gloves and booties, a respirator, and goggles. The best available rubber gloves were selected, following a study of product penetration through various types of gloves. Industrial hygiene further studied the work environment through continued attendance, observation, and atmospheric sampling. A swab test for parathion was developed for use inside kettles before maintenance personnel were permitted to enter. This test was used on floors and equipment to locate spills and to determine the extent of clean-up. All maintenance personnel were required to be clothed properly and to observe the same precautions as did operators. Visitors were limited to those properly dressed.

Some dust impregnation, blending, diluting, and packaging were undertaken. In this work, mechanical exhaust ventilation, complete enclosure and dust collecting provided a practically remote control operation free from dust or vapor exposure. The plant medical department performed routine cholinesterase determinations on blood. Application of the principles of industrial hygiene to the production of a toxic pesticide resulted in a very desirable place to work. In fact, working conditions were such that soon other personnel in the plant became interested in transfer to the new department. Needless to say, production was not interrupted because of employee illness.

The work of the industrial hygienist did not stop at this point. It was evident from the start that those companies that were to impregnate carriers for liquid parathion and to formulate and market dilute dusts, wettable powders, and emulsions would be confronted with problems of health maintenance among their own employees. Likewise, persons who used the organic phosphate–type pesticide must be protected during field application. Therefore, advices were prepared for the health protection of these formulators and users of parathion. Such advices followed the product into the hands of those conducting early field application experiments.

Cooperation with Formulators

Over 125 visits were made by our industrial hygiene group to companies that were to formulate parathion products for marketing. In addition, visits were made and studies were undertaken to determine protective measures necessary for health maintenance of those engaged in field application of parathion.

The plants visited were provided with manuals containing a section on industrial hygiene recommendations. Included were schematic drawings of typical dust mixing equipment, to which was applied the engineering design for dust and vapor control. Advice was given on unloading parathion liquid from drums, on impregnating in closed mixers, for dust control in loading mixers or when dumping into the boot of an elevator. Enclosed and exhausted bagging and drum filling stations were sketched. Small packaging procedures were restricted to well-hooded and exhausted booth enclosures. Protective clothing and personal worker cleanliness were stressed. In addition, advice was given for avoiding worker contact while crop dusting or while spraying with wettable powders. Precautions for pilots and helpers were listed for use in conducting field application by airplane.

Respiratory protection was developed and tested and manufacture and distribution of protective equipment was encouraged. This program of service to customers and to others, in order to avoid employee inhalation of dusts or vapor or product contact with the skin, was arranged through our sales group with the cooperation of pesticide formulators. The result has been a successful experience in avoiding a large incidence of potential illness in production, marketing and use of a highly toxic but extremely beneficial pesticide.

Another portion of our medical department's activity has been publication and extensive distribution of toxicological findings in connection with this product. Also widely publicized and distributed to physicians has been the information on the symptoms associated with illness, as well as the development, publication, and assistance given to formulators and users of pesticides in connection with testing and interpreting cholinesterase activity in the blood. Through this test, it has been possible to determine early accidental absorption, thus preventing illness.

It is believed that efforts expended towards the prevention of occupational illness among those handling toxic substances has assisted in developing a new philosophy among those producing, marketing and using such materials. Indeed, we have seen a dramatic change occur in the production techniques in pesticide dust formulating plants. The precautionary measures for handling that have been instituted for parathion have resulted in production facilities that demonstrate what can be done to improve working conditions. We find that it is no longer necessary for employees to formulate pesticides in a cloud of dust or breathe toxic vapors as part of the conditions of employment. Comfort, lighting, housekeeping, and shower and locker facilities are improved. Employees change work garments at the end of the day and no longer wear home the dust from the plant in their clothing. Money has been spent for dust collecting systems and mechanical exhaust ventilation has been applied locally at the source of dust dispersal.

A controlled workroom environment in pesticide formulating plants is proving economically desirable and worthwhile. Such plants, equipped with production facilities for maintaining healthful conditions of work, are thus prepared to handle any new insecticide yet to be developed with potential toxicity to humans comparable to that of the organic phosphates. Just as important is the fact that these formulators have provided a working environment that will attract and hold desirable, trained employees. Also, they have speeded production, salvaged product formerly lost by dispersal about the workroom, reduced housekeeping costs, avoided employee occupational illness and the potential of compensation litigation in this respect. Rates for occupational disease insurance coverage have been reported reduced and complaints of atmospheric pollution are ending.

Such is the story of industrial hygiene at work in the development, manufacture, formulation, and use of pesticides.

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