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The Safe Handling of Chemicals in Industry and in the Home

D. D. IRISH
Biochemical Research Department
The Dow Chemical Company

CHEMICAL injuries are actually a small part of our total picture of accidental injuries. However, like other types of accidental injury they are unnecessary. In other words, we can do something about them. Your problem, like my own, is the responsibility for many people who may handle chemicals. Our problem is then largely one of inducing people to handle them safely that is the heart of my topic today rather than the details of safe practice. You remember the old saying "You can lead a horse to water but you can't make him drink." Our greatest problem is to induce him to drink.

If we are to discus 'chemical substances,' we should consider what they are. We can certainly not rely upon the popular idea that a chemical is a 'dangerous stuff which stinks.' Broadly, everything we use is of a chemical nature. We are really dealing with practically any individual substance which may be used in industry or in the home. But, you may say, we are of course interested only in hazardous substances. Let us then consider what a hazardous substance is. In general, the term poison conjures up lurid visions of witches' brew and black magic. In such matters we must realize that we are dealing more often with emotional thinking than with rational thinking.

Let me give you my own definition of the term poison: "A poison is too much." Now I assure you I am not being facetious, I am very earnest in this definition. Let me illustrate by describing a very simple experiment which time does not allow me to perform for you. We are frequently asked, "Is this substance a poison or is it not a poison?" If we were to ask the individual what he means, he would simply say, "Why give it to an animal, and if he dies it is poison, if he doesn't, it is not." Let us outline a simple experiment by taking four mice and giving them by mouth one of four different substances. Those substances which kill the animal we will classify as deadly poison and those from which the animals show no discomfort, we will classify as entirely harmless. When two of the animals die we examine the record and find that they received the two deadly poisons, table salt and baking soda. The other two animals who lived happily and contented were given the innocuous substances known as strychnine and white arsenic. Now there is no trick or magic to this experiment, it is just a matter of amounts. We gave the animals more table salt and baking soda than we gave of strychnine and white arsenic. This is not a matter of a substance being a poison or not a poison, but it is a matter of whether or not the substance gets into the animal body in excessive amounts. You can readily kill an animal by an excessive amount of table salt or baking soda, but there is no reason in the world why you should. In the same way, we can readily kill an animal with an excessive amount of strychnine or white arsenic or nearly any other material, but there is no reason why we should. We realize of course that the smaller the toxic dose the easier it is to get a toxic amount and the more careful must be the handling precautions.

A CHEMICAL substance is not of malicious intent. It will not, with malice of forethought, reach out and bite us. It has consistent and definable properties. If we ignore these properties and misue the substance, we can expect trouble. We see that we ourselves, in our own acts, contribute an essential part of the pattern leading to injury. Therefore, with more knowledge, and less disregard for the knowledge we have, we can eliminate to a large degree, the hazards of misuse.

There are three basic modes of contact to be considered in the practical problem of handling a substance. The breathing of an air dispersion (dust, vapor, mist, etc.), contact on the skin or eyes (with either irritation or absorption), and entrance by mouth. The practical hazard of breathing air dispersions is not determined solely by

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the toxic concentration. The ease of obtaining a toxic concentration is just as important, and this depends not only on the physical properties of the substance but also on the circumstances of use. Whatever the mode of contact and entry to the body, the ease with which excessive amounts may by contacted is more important than the toxicity alone. In other words, the toxicity is not a measure of the "practical hazard."

The "practical hazard" is determined by the physical, chemical, and physiological properties of a substance plus the circumstances of use. The subject of interest to us is actually the "practical hazards" of our contemplated use.

So far I have emphasized the toxic hazard. We should never forget the fire hazard. It has been by all means more damaging to life and property. As a friend of mine expressed it in a general discussion on hazard warnings, "We will blow more people through the windows with carbon disulfide than we will ever poison with it in spite of the fact that it is a highly toxic substance."

In one way we are a step farther ahead in considering fire hazards than we are with toxic hazards. Most people are more realistic and less emotional in considering a fire hazard. We are in general more cognizant of the fact that something can be done about them. However, be it fire hazard or toxic hazard, the basic fault is in misuse.

It is obvious then, that our problem is one of eliminating misuse. In order to do this, we must recognize what constitutes misuse of any particular substance and we must define what is proper use. Even after we have this information, it is necessary that we diseminate this information to the individuals who may handle the substance and convince them to apply safe handling practice.

WHILE there are certain basic similarities between the problems in industry and the problems in the home, there are also certain differences which make it desirable to consider each one separately. Let us then turn our attention first to our industries. In considering industries please remember that the agricultural industries are our important industries, and should not be neglected by those people whose responsibility it is to concern themselves with industrial health and public health.

If you are faced with a decision in regard to the design and operation of a process entirely new to your organization or area, you will probably want to investigate the known information as it appears in the literature. Let us then examine a typical case of a particular substance.

I quote in part from an abstract concerning the use of this particular substance we will call X—"Onychia Due to Handling X." "All but two finger nails of a woman working with X were affected...Some nails were stripped off, others were split and lifted from the bed. Granular tissue could be broken away when the nail plate was lifted...The condition cleared up when the woman stopped her work."

I quote in part from another abstract concerning the industry manufacturing X. "Usually the disease begins with slight fever, chills, and malaise. A localized infiltrated patch appears in the healthy skin which in a few days develops the characteristic of an extremly painful boil, with lymphangitis and adenitis...Laborers in the X manufacture usually present a squamous dermatitis between the fingers and on the back of the hands...X causes gingivitis...In extreme cases the teeth fall out."

In considering the facts presented by this abstract, you might readily consider that you would be faced with some serious health problems in operating such a plant. However, we note that the substance X is 'sugar.' This puts a rather different light on our interpretation of the fact. In analyzing our own thoughts, then, we realize that we may be as much affected by a somewhat emotional consideration by which we ignore the problems associated with a familiar substance and greatly overemphasize the problems associated with the use of a substance with which we are not familiar. This is not entirely unjustified because we have more reason to be confident of the information on a familiar substance. Too often, however, we find to our surprise that we have more information on a new substance than on some old familiar ones. Many of our older materials are accepted just because we are getting by.

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We often observe in people handling chemicals, a respect for a substance with a disagreeable character such as an odor although there are no serious hazards from its use. At the same time we see disregard for the hazards of a substance without disagreeable characteristics although verbal warning has been given of its potential health hazard. In a like manner a workman is often concerned over a small superficial irritation which is an obvious nuisance while apparently unconcerned over serious potential internal injury which may not be physically obvious to him at the moment.

IN APPROACHING the problem of a new process in industry, we obtain what information we can from literature and from the toxicological laboratory as to the physiological effects of the substances. We also obtain as much detailed information as we can about the physical and chemical properties of the substances and the mechanics of the operations in a proposed plant for manufacturing or using these materials. From this information we should be able to put together a picture by which we can determine the possibilities of exposure in the operations and from the toxicological information determine whether or not these potential exposures represent a practical hazard. This is of course much simpler to state in a few sentences as I have stated it, than it is to accomplish in fact. The discussion of the details of working out this problem are beyond the time which we have available today. Let us assume that we have accomplished this survey, and have a pretty good comprehension of the problems which we may encounter and the means of safe handling of the material. How are we going to implement that in our industry so that we are successful in eliminating misuse and misoperation?

The first and most important step in industry is to get our chemical engineers and designing engineers to recognize that the potential hazards involved in the manufacture and handling of the materials are as much a part of the problem of design and operation of a plant as are the physical properties of the substance or, for that matter, the load on the structural members of his building. If we can get the designing engineer and the building engineer to take these factors into account in the original layout of his apparatus, we are making the most important step towards safe operation at a minimum cost.

The second main object to be attained in the industry is to convince the operator that the proper use and handling of a material in his operations is just as important as the control of temperature and pressure in his process, or the productive output of his plant. When the operator accepts the health problems of his operation as part and parcel of the regular operating duties, then we have a good chance of eliminating injuries due to exposure to the substances in his process.

The final answer to our problem in industry comes from the success we have in putting across an understanding of the problems to the people in design and in operation. The attainment of the proper knowledge of the subject is just the beginning.

Please excuse me for a great over-simplification of the problem in industry. But as I want to leave these two main approaches with you, I do not want to go into further detail in discussing the industry's problem. The two factors, first, of accepting toxicological properties of a substance as a logical part of the problem of basic design; and secondly, of accepting problems of exposure as part of good operating technique, are fundamental to the elimination of health hazards in industry.

NOW LET us turn to the home. The greatest difference we have between the industry and the home is the fact that in industry supervision has some control over both the engineering of a process and the individuals in operation. In the home we have no direct control and very few channels for passing on information concerning the safe use of materials.

Recognizing the possibilities of oversimplification, I want to reduce the problem as it occurs in the home to the three factors that I feel are the greatest contribution to accidents with chemicals:

We will recognize that the label, containing the information on the proper use of a substance and any warnings as to certain misuses of the substance, is our most direct channel for informing the in-

dividual in the home. Our first great difficulty is the fact that people neither read the labels nor apply the information contained theron. An attempt to get people to pay attention to the information contained on the package within which they receive the material would be a very great step forward in avoiding misuse of the material in the home.

Our second difficulty is created by improper storage. Mother brings home the groceries including a can of rat poison and dumps them all out on the kitchen shelf with the intention of putting them away later. Meanwhile, little Johnny explores to see what he can find. 'All substances which are not to be eaten should be stored away from food stuffs and out of the reach of children.

The third major factor is of the greatest importance by far. I refer here to the tendency to transfer various substances to common containers around the house, such as a drinking glass or a pop bottle, which are then left readily available to children or other adults. This is probably the source of the greatest problem in handling substances in the home. Very much in the same category will fall the individual who purchases a small amount of material in the corner store and has it poured out into a pop bottle or other unlabeled, unidentifiable container, which he then proceeds to take home and leave where it is easily available to people who are not at all familiar with its content.

LET'S EXAMINE but one result of such procedure. You will recognize immediately that it is not the most hazardous substance that causes the most difficulty in the home. Such a common material as kerosene which in itself is certainly not a highly toxic material, accounts for many of the serious poisonings in children throughout the United States every year. Practically all of these cases are completely inexcusable in that mother or dad poured some kerosene into an ordinary drinking glass and then left it where a child could pick it up. This is certainly the most common pattern. Kerosene is not singled out here as a toxic substance, actually, just the reverse. Nearly any other organic fluid under the same circumstances would represent just as much of a problem and many of them vastly more. Actually, kerosene emphasized my point that the toxicity of a substance is not by any means the important part of the problem. Kerosene is among the least toxic of the organic fluids with which we would be concerned in the home. The problem is that it is one of the most common available and probably the most carelessly handled.

Think of the almost unlimited number of common substances used around the home, washing compounds, household insecticides, agricultural chemicals, disinfectants, dry cleaning materials, common solvents, natural gas, gasoline, turpentine, and many others. They vary in flammability and toxicity from potentially highly hazardous to almost innocuous, yet every one of them can be misused in some way. At the same time there is not one of them, no matter how hazardous it may be, that cannot be used with safety, if its properties are understood and it is handled with due consideration to its properties.

I could have given you a long dissertation on the detailed hazards of individual chemical substances and a tabulation of the various ways in which we could avoid difficulties. Practically all of this information has been published in some form. It appears in brief form on package labels and in more detail in the general literature. Much of this is already known to you. In analyzing the whole picture, it seems to me that while this information is important, there is still the matter of convincing the people directly concerned to actually eliminate misuse. I have tried to discuss for you some of the more obvious angles of this problem of inducing people to apply some simple common sense to the handling of chemical substances in the industry and in the home.

We all recognize that it is possible with the proper knowledge and care to handle practically any substance, no matter how toxic or flammable. We also recognize that we can misuse nearly any substance so that there may be hazard to the health of individuals concerned. Our aim is not to eliminate materials from our industries or from our home because they may be flammable or toxic, but our aim is to eliminate careless or ignorant misuse so that you and I and everyone else can enjoy all the advantages of these substances.

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