The Role of Reodorants in Industrial Odor Abatement

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The use of aromatics and essential oils to counteract malodors is unquestionably the oldest form of odor abatement. Our own country was discovered by voyagers on their way to the East Indies to obtain dyes, spices and perfumes. The Bible tells us that the three wise men brought Jesus gifts of gold, frankincense and myrrh. The latter two represent aromatics and actually were valued higher than the gold. Even before this time, the Egyptians were experts in the art of masking odors with aromatics. One of the basic differences between ancient and modern applications of reodorants is that frequently their original use was to counteract the lack of good housekeeping practices, while today we recognize the fact that reodorants should only be used after all practical procedures have been employed.

Before proceeding further with the discussion, it is well to set forth a few definitions which will provide a common language and thus lead to a better understanding of the forthcoming material. The definitions given are somewhat arbitrary but, for the most part, can be considered as authoritative. They are designed to provide a practical explanation of commonly used (and misused) terms.

1. Air Pollution: The discharge of foreign matter—solid, liquid, or gas into the atmosphere. This may be odorless, malodorous or pleasant smelling.
2. Odor Nuisance: An odor, pleasant or unpleasant, which persists in the atmosphere to a point where objections to its presence are made public.
3. Masking: The act of superimposing one odor over another so that only the *new* odor can be perceived.
4. Reodorize: The act of superimposing one odor over another so that the original odor cannot be perceived. The superimposed odor may predominate or the effect may be to create a third (and more pleasing) odor.
5. Deodorize: The act of completely removing all odor. This may be accomplished by a physical removal of the odor or by *complete* oxidation.
6. Neutralize: To destroy the effect of an odor; this is really a poor term to use in odor control work except in the case of gases such as hydrogen sulfide (H_2S), where actual chemical neutralizing can be accomplished.

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7. Reodorant: Any odiferous substance which will reodorize an industrial malodor. Usually these will be liquid preparations containing aromatics and/or essential oils which have been rendered water soluble. As such, they may be diluted with water for spraying or they may be added to liquid waste.

For the purpose of this discussion, we prefer to treat the terms "Air Pollution" and "Odor Nuisance" as different entities; i.e., they are not synonymous. It is true that coexistence of the two is possible but a pollution problem may be evident without an odor nuisance being created and conversely an odor problem may exist without any measurable degree of pollution. (This will be borne out further when we discuss the limits of odor perception.) It should also be understood that the use of reodorants is limited to *odor* abatement and that reodorants are of no value in mitigating pollutional problems; in fact, the misuse of reodorants can actually create a pollution problem where none formerly existed. (This is unlikely because of the economics involved but nevertheless serves to illustrate a point.)

Probably one of the most important and often one of the most difficult tasks of the air pollution officer is that of determining if the existing problem is one of air pollution or odor nuisance. It is generally conceded that malodors in themselves do not constitute a health hazard other than perhaps the mental anguish created. (Which is probably hardest on the plant manager.) The rendering of chicken offal and chicken feathers creates an odor problem which is in a class by itself and few if any such plants have escaped being openly criticized and there are many examples of such plants being closed by a court order. While the proteinaceous decomposition products discharged to the atmosphere by one of these plants are no doubt significant, the plants are not cited on the basis of pollution, but rather on the basis of creating an odor nuisance. While most waste lagoons are pleasant by comparison they can be placed in the same category insofar as their classification by air pollution authorities.

While a theoretical approach is beyond the scope of this treatise, it is well to consider briefly the mechanism of odor perception. Several theories have been expounded as to the exact cause of odor perception but none of these has been universally accepted. The most recent theory set forth is that of low frequency molecular vibrations and their effect upon the olfactory nerves. The basic argument for this theory is that the odor property of a substance is found to be a "whole-molecule" effect rather than the effects of certain functional groups or bondings

and low frequency vibrations also represent a "whole-molecule" property. Logical as this may appear, one cannot completely disregard the possible effects of functional groups, for certain atomic groupings have been shown to provide definite and similar odor characteristics to different molecules. Groupings of this type are referred to as osmophores which are analogous to the chromophores used by the dye chemist. Spatial configuration of the molecule is also a factor and it has been shown that two materials unrelated chemically but with similar molecular structures will exhibit like odor characteristics.

One point of agreement by all proponents is the fact that to produce a perceptible odor, the substance must be in a gaseous (vapor) state. Discrete particles do not produce odors; smoke which is composed of colloidal carbon is odorless. The odor associated with smoke is due to the gaseous products of incomplete combustion.

Knowledge such as this is applied in the development and application of reodorants. Thus, vapor pressure data becomes an important tool for the formulator when deciding upon a specific blend of aromatics to be used as an industrial reodorant.

In spite of our high development of instrumentation, no one has devised an instrument to replace the olfactory nerves as a means of odor detection. Unfortunately, sensitive as the nose is, it does not permit us to make a true quantitative evaluation of odor. Furthermore, other sensory perceptions and the matter of association have a pronounced effect upon our evaluation of an odor. Odor problems exist as they do today because of the high sensitivity of the nose. The sensitivity of the nose is indicated by the fact that odors such as methyl mercaptan can be perceived and identified at levels as low as one part in one hundred million ($1:1 \times 10^8$). A good industrial reodorant must have a threshold value approximating this if it is to prove economically practical. We have prepared industrial reodorants with aqueous threshold values of $1:1 \times 10^{10}$. It becomes immediately obvious that with highly odoriferous substances an odor problem can be created long before a real pollution problem manifests itself. Furthermore, the use of an effective reodorant is not likely to create or aggravate a pollutional problem.

The use of reodorants represents but one approach to odor abatement problems and in order to fully appreciate their value, it is necessary to give consideration to other methods of control. In this way reodorants can be placed in their proper perspective and thus "used" rather than "mis-used" as is frequently the case.

There are many ways of classifying odor problems and odor abatement methods. Probably the most basic approach is that of dividing odor-producing substances into solids, liquids and gases and then proceed to list the available methods of control for each. However, all odors are gases, a fact which has been established, hence for the sake of brevity, we have chosen to start with two broad classifications of industrial odors.

I. Malodorous vapors which may be collected and vented out a common duct.

II. Malodorous vapors which cannot (for practical reasons) be so collected.

It becomes immediately obvious that the job will be more simple if the first set of conditions can be met, and this should be of primary consideration in the construction of new plant facilities. Costly as the necessary equipment may be at the outset, it will cost many times more if installed after the plant has been constructed unless specific provisions have been made for its installation at a future date. The following list of odor abatement methods are applicable where the odor producing gases are collected. (While we are speaking of gases it must be understood that particulate matter may be present in the gas or vapor stream.)

Odor Abatement Methods

1. Scrubbing
   a. Water
   b. Chemical Solution
2. Adsorption
   a. Charcoal
   b. Silic-Gel
3. Combustion
4. Catalytic Combustion
5. Electric Precipitation
6. Oxidation
   a. Chlorine
   b. Ozone
7. Reodorization

In the sugar beet industry, both solid and liquid wastes are encountered and both represent sources of odor. The solid waste, if permitted to stand in a heap, especially in a warm climate, will undergo decomposition similar to any other organic waste and an odor nuisance will be created, to say nothing of the insect breeding potential. Periodic spraying of solid organic waste with the proper reodorant is both effective and economical. Actually for an application such as this, a combination reodorant-bacteriostat preparation is advisable or one containing reodorant,

bacteriostatic and insecticidal agents. This type of spray will provide immediate odor relief and slow down the decomposition process so that malodor production is minimized.

Most industrial reodorants will be supplied as water soluble concentrates and, therefore, they are applied in the form of an aqueous solution or emulsion. A high pressure agricultural spray unit represents the best means of applying the reodorant mixture but in the absence of such equipment, any device which will permit saturation of the stack exterior can be utilized. The rate and frequency of application are matters for individual consideration and are dependent upon such factors as ambient temperatures, humidity, physical construction of the stack and proximity of the waste to residential areas. Other industries have found this method of stack odor control to be economically feasible and there is no reason why the sugar beet industry should be an exception.

Liquid organic waste, when fresh, presents no odor problem, however, bacterial degradation proceeds immediately and a waste may become very odiferous in a matter of a few hours. In instances where water is reused by recycling before being discharged, it will be in a partially septic condition prior to leaving the plant. To reduce the odor problem where water is reused, a bacteriostat or a combination bacteriostat-reodorant should be fed continuously and proportionately into the makeup water.

As the liquid waste leaves the plant it can be treated with a reodorant which will provide odor control either for lagooning or ditching, in the event the waste flows in an open ditch on its way to a public stream or public disposal plant. In the treatment of liquid wastes care should be exercised in the selection of a reodorant if B.O.D. reduction is a factor. (Consideration must also be given to the type and amount of bacteriostat, if any, added to the recirculated water in the plant.) The reodorant used for this purpose should be one which has been subjected to pilot plant tests to determine its effect upon B.O.D. reduction in sugar beet waste. It is quite possible for a reodorant to show no bacteriostatic properties in one medium, yet have definite inhibitory effects in another at the same concentrations.

Treatment of liquid wastes with a reodorant is simple. In many instances, it can be fed directly from the original container by attaching a needle valve to the drum. Where the volume of reodorant consumed is small, it is best to feed a water mixture. This may be dripped into the waste from a container or fed by means of a chemical feed pump. Intermittent feeding is not advised although it has been used, in instances, with a fair degree

of success. The rate of feeding will vary from five to fifty parts per million, depending on the nature of the waste and degree of odor control desired. Industrial reodorants are successfully used in the treatment of organic wastes (for odor abatement) by industries as well as municipalities.

Reodorants can be incorporated in the general clean-up program of the plant. A small amount in the last rinse water will provide a clean pleasant odor throughout the plant. If frequent visitors are encountered the effect created will be of pronounced psychological benefit. While a good industrial reodorant will be sensibly non-toxic, it must, of course, be applied in a manner which will not cause contamination of foodstuffs. This need not present any more of a problem than does the use of ordinary cleaning agents.

Up to now, we have considered only the physical aspects of odor control. The psychological factor cannot be taken lightly, as many times it looms above all others. To begin with, the lay person will associate odors with some mental picture which is familiar to him. Odors are not necessarily objectionable because of their particular character but often times because of the association one has with that specific odor. For example, it is questionable if raw fresh sewage odor is any worse than the exhaust from a diesel engine, yet most people would be less "offended" by the latter simply because of the association attached to each odor.

Likewise, one's attitude toward the odor being emitted from a plant will be colored by the feeling that the individual has toward the plant. If the relationship of the plant with the community is in general a favorable one, then for the most part the people will be more tolerant when malodors are experienced. It behooves any plant to foster good public relations and one way of doing this is to be the first to recognize an odor problem when it exists and to make the first move toward its abatement. The plant that has to be prodded by the community is always behind in its public relations program. Certainly any self-respecting plant will wish to make an honest effort toward odor abatement and if this effort is made before community pressure is applied, the action can take place in a more methodical and more economical fashion.

The proper approach to any odor problem involves a careful study to determine what logical steps may be taken to mitigate the condition. A slight change in plant procedure, more expeditious handling of perishables, segregation of wastes and last but certainly not least, good housekeeping tactics can often lead to an improvement in overall conditions. After this has been

done it is time to select the method of odor control to be used. Reodorants certainly belong high up on the list of possible abatement measures. They are applicable in most every instance and frequently represent the only practical approach.

In the selection of a reodorant, look beyond the price tag. Remember that here, as with other commodities, the consumer usually receives in proportion to what he pays. Select an organization capable of providing technical service and one which has the necessary laboratory facilities to cope with special problems. While we can learn from the Egyptians, we need not be limited to either their materials or techniques.

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