TECHNICAL SAFETY SYMPOSIUM

INTRODUCTION

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BY WAY of a few introductory remarks concerning the six articles pertaining to plant safety which were presented during the Safety Symposium at the September 24–26, 1956 meeting of the American Oil Chemists' Society, it might be mentioned that President T. H. Hopper and the Governing Board, on the occasion of the Spring meeting in Houston, decided to establish a permanent Technical Safety Committee to round out the engineering service that the Society is performing for the oil and fat industry specifically and for the general public as a whole. It is planned that the committee will be composed of three subcommittees whose membership would have a major interest in solvent extraction, or laboratory, or general plant operations; these subcommittees, in turn, will be composed of Task Groups which will attack one or the other of the problems which concern the committee.

In addition to handling specific tasks, such as studying extraction-plant solvent-loss problems or general plant-corrosion problems from a technical safety viewpoint, the committee's work will also be directed toward creating an atmosphere of safety within the oil and fat industry by encouraging the presentation at the Society's meetings and publication in the Society's Journal of papers dealing with fire and health problems confronting the industry as well as studying and re-evaluating current safety regulations and practices. People tend to cling to their illusions and customs with great tenacity so, in order to eliminate an undesirable practice or to gain acceptance of a new but desirable concept, it often is necessary to apply the weight and force that only is possible within an organized group. By each member of the committee and each plant or company contributing a bit, the aggregate should result in an improved safety record for the oil and fat industry. Any individual who thinks that he can contribute something worthwhile is asked to volunteer his services rather than wait for the various chairmen to ask him since they may not be familiar with his situation.

The Role of Personnel in Safety of Solvent-Extraction Operations

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THE SUBJECT OF SAFETY in solvent-extraction operations has received an increasing amount of attention over the past few years. The increase in interest is quite natural in view of the rapid expansion which this method of processing has enjoyed.

A study of the literature on safety will reveal that most of the rules, regulations, and advice set forth are sound and well worth heeding. No effort will be made to review the literature, nor will we attempt to cover the whole field. Rather we would like to confine our discussion to the influence of personnel on safety.

Personnel selection is the first step toward safety in solvent-plant operation. The employee should have the intelligence to understand the operation and the hazards involved. He should be thoroughly reliable. A person who does not meet these requirements will endanger not only himself but his fellow workers and the property of his employer. Obviously a person who is highly nervous or excitable is not suited for solvent-plant operation. In emergencies a person of this type may act before thinking, and such action can prove fatal. On more than one occasion the writer has seen unnecessary personal injury result from spur-of-the-moment action. It is a matter of record that some people are susceptible to accidents. Such people serve as originators of accidents and, in the case of hazardous operations, it frequently happens that the originator is not the only person to suffer injuries. One individual can serve to break down morale and disorganize an entire group. The extreme of this type appears at times to be "rehearsing for an accident" and might be compared to the driver who weaves in and out of traffic on a crowded highway.

The importance of proper instruction and training of the new employee should never be under-estimated. An effort should be made to develop the proper attitude in the employee. An attitude of fear is not a healthy one, and it is generally true that we fear the things we do not understand. Instruction and training should be directed toward having the employee understand the operation, recognize the hazards that exist, respect these hazards, but never fear them. In starting up new plants, the author has seen untrained people develop such a deep fear of the operation that it was necessary to transfer them to other jobs. It is much better if these fears can be recognized before hand; unless they can be overcome, the employee should not be assigned to the solvent plant.

Ideal conditions for training exist when new employees are hired for an existing operation. Here the new man can receive his training and develop a degree of self-confidence while working side by side with trained personnel. In the case of a new plant it is highly desirable that operating personnel be given prior training at an existing installation. If this is not possible, the burden of training must fall on the shoulders of a few key men and problems become more acute.

IT IS STILL TRUE that "actions speak louder than words." Along with instruction the use of fire-fighting equipment should be demonstrated. Methods of coping with other emergencies which may arise

should also be demonstrated. This includes the use of first-aid equipment.

There is an old saying "familiarity breeds contempt." We must be constantly alert to see that this does not apply to us as solvent-plant operators. Where operation proceeds smoothly over a period of time, there is the danger that carelessness may creep in and disregard for hazards may develop. It is up to supervisory personnel to see that this does not occur.

Safety inspections and checks of safety equipment should take place at specified intervals. This is done preferably by the safety director or some other person who is not a member of the operating department. Such a person is more likely to recognize potential sources of trouble than are those who live with the operation day by day.

Unscheduled shut-downs of a solvent plant are expensive, and frequently temporary repairs will be made to prevent a shut-down. Such temporary measures should not compromise safety and should not involve undue hazards. Decisions in these matters require an accurate appraisal of conditions and the exercise of sound judgment. The expense of a shut-down is preferable to continued operation under hazardous conditions.

A review of the safety records of solvent plants will reveal that most of the serious accidents can be traced to carelessness, disregard for hazards, and failure to observe established safety measures. Realization of the ease with which some of these accidents could have been prevented is indeed distressing when one considers the cost in suffering, human lives, and destruction of property. Each member of the operating team should resolve to be ever alert so that he does not endanger himself, his fellow workers, or the property of his employer.

Special Equipment and Operating Features Which Contribute To Safety in Extraction-Plant Operations

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IT IS, OF COURSE, difficult to over-emphasize the importance of safety in our extraction plants because a safe operation has tremendous bearing not only on our personal safety but on our jobs as well. There are very few minor fires in extraction plants; any fire at all is likely to be a major one, resulting in serious loss of property, personal injury, and extended loss of production.

It is our intention to discuss certain special equipment and operating features which can be built into the extraction phase of an oilseed processing operation to improve the safety rating. These remarks will be limited to the hazards peculiar to hexane solvent-extraction plants and more particularly to the fire and explosion hazards inherent in such an operation. Such special features will be discussed from an engineering point of view as they affect the safety which we all want to have in our operations rather than from the point of view of the plant-safety supervisor or the insurance man. In some cases, of course, these three viewpoints, engineering, safety, and insurance, are identical; other cases arise however where good engineering judgment indicates a limit to the safety equipment which should be installed in a plant. This does not mean a de-emphasis of safety but rather a need for more emphasis on the personnel and operating phases of safety. It is probably impossible to build a solvent-extraction plant which cannot be blown up by poor operation or careless personnel.

Before discussing specific safety items, it would be well to review the physical properties of hexane, the most commonly used solvent, which make it a hazardous liquid. Hexane is a relatively low-boiling solvent, which means that it has a relatively high vapor pressure at any given temperature and that, at any place where there is hexane liquid, we are likely to encounter a rather high concentration of vapors. Fires and explosions, of course, do not take place in the liquid as such but only in the vapor phase and specifically only when the vapors are mixed with a proper amount of air or oxygen. When expressed as percentage by volume, the explosive limits of hexane in air are 1.2% for the lower explosive limit and 6.9% for the upper explosive limit. Another way of looking at this would be to determine by calculation at what temperatures of the liquid we will have a vapor over the liquid in the proper proportion with air to form an explosive mixture. By calculation, we find that the lower explosive temperature, if we can coin a phrase, is —5 degrees F., which corresponds closely to the closed cup flash point. The upper explosive temperature is found to be approximately +35 degrees F. Hexane liquid and vapors, which are at equilibrium with air in a confined space above this upper explosive temperature cannot be ignited and are therefore relatively safe; it should be noted however that equilibrium conditions are attained rather slowly because of the wide specific gravity difference between air and hexane vapors.

Normal extraction operations in which hexane is present are carried out in the range of 120° to 155° F. so that as long as there is liquid hexane present in these operations and the system is confined, the vapors over the hexane will be above the upper explosive limit and do not represent a hazard. The major hazards in extraction operations therefore arise from two causes: one, when the liquid is not confined to a closed space; and two, during start-up and shut-down periods when the equipment is cold and/or equilibrium conditions are not present.

The seven basic rules for the safe handling of flammable liquids in general are to (1) isolate the hazard, confine the liquid, ventilate to prevent explosive mixtures, instal explosion vents where needed, eliminate ignition sources, educate employees on hazards and safeguards, and provide adequate fire protection.

With this outline in mind a number of safety features which can be built into an extraction plant to improve the safety rating of the operation will be