Sampling and Analysis

Airborne methyl alcohol concentrations can be measured directly with chemical indicator tubes [55] by passing a known volume of gas through the sampling tube, thus producing a stained zone on the indicating portion of the tube; the length of the stained zone is a measure of the concentration. As these tubes tend to give very high results, [55] they are suitable only for the approximate assessment of airborne concentrations and qualitative surveys. Moreover, they are not specific to methyl alcohol since they are also used for ethyl alcohol. [55]

Smith and Pierce [56] have shown that certain plastic bags will retain up to 97% of the methyl alcohol in air sampled for up to 120 hours at concentrations from 100 to 400 ppm. This particular sampling method is bulky and is applicable for peak and ceiling determinations and for TWA determinations if a sufficient number of small samples or a sufficiently slow sampling rate is used.

Rogers [57] reported that a midget impinger, containing 10 ml of distilled water as a sampling medium, had a collection efficiency of approximately 92% for methyl alcohol at concentrations of 200 and 400 ppm (260 and 520 mg/cu m). These sampling efficiencies were reported at sampling rates of 1-3 liters/minute. When a fritted glass bubbler was also tested using 10 ml of distilled water, the collection efficiency was approximately 91% and 96% for methyl alcohol concentrations of 200 and 400 ppm (260 and 520 mg/cu m), respectively. The major disadvantage of the fritted bubbler is that it limits the sampling rate to around

1 liter/minute. Additionally, the collection efficiency of water was slightly impaired when the methyl alcohol concentration of the solution exceeded 5 mg/10 ml. [57] A significant disadvantage of collection in a liquid system is that sample loss can occur from spillage or evaporation during the actual sampling, or in transit for analysis.

Silica gel has been tested and used by some investigators for sampling solvent vapors. [58,59] One significant problem of this method with regard to methyl alcohol sampling is that the presence of high water vapor concentrations (85-95%) in air reduces the collection efficiency when the total amount of silica gel in the sampling tube is 150 mg (100 mg adsorbing section; 50 mg backup section). [58] The use of larger tubes containing 850 mg silica gel (700 mg adsorbing section; 150 mg backup section) has succeeded in effectively preventing the interference of water vapor in the collection process over a range of 100-1,000 ppm methyl alcohol. [60] An obvious advantage of collection on a solid medium such as silica gel is that sample loss cannot occur from spillage during sampling or in transit for analysis.

Infrared spectrophotometry has been successfully used for the qualitative analysis of various compounds, including alcohols. For quantitative analysis, however, there are practical problems, such as cell width and complexity of spectra which could cause overlapping of the spectral components of the sample, and narrow peaks which could cause deviations from Beer's law, as mentioned by Skoog and West. [61]

Numerous colorimetric methods for quantitative analysis of collected samples of methyl alcohol have been used. [57,62-65] These methods are based on the following principle: methyl alcohol is oxidized to formaldehyde with potassium permanganate. The formaldehyde is then reacted with Schiff's reagent [57,62,63,65,66] or rosaniline solution [64] to produce an easily recognizable and stable color. In recent years however, gas chromatography has become the more prevalent method for the analysis of organic solvents. [58,67-70] This method is particularly desirable since it is capable of analyzing for other substances simultaneously with methyl alcohol.

Appendices I and II present the recommended methods for the sampling and analysis of methyl alcohol. Briefly the sample is drawn through a silica gel tube, desorbed with distilled water [60] and analyzed by gas chromatography. [69] The sampling device is small and portable. The sample can then be analyzed by means of a rapid, relatively specific instrumental method, with minimal interferences, most of which can be eliminated by altering chromatographic conditions.

Environmental Levels

Little information has been found concerning levels of atmospheric methyl alcohol in industry. In 1917, the New York State Industrial Commission [14] made a survey of the artificial-flower industry, in which methyl alcohol was used as a dye solvent. In one factory, the airborne level of methyl alcohol was found to be 200 ppm W/V. In many instances, the vapor was noticeable at a distance of 75 feet from the dipping and drying operation. Since the minimum detectable odor for methyl alcohol, as reported by May, [21] was 5,900 ppm, it would appear that the airborne concentrations of methyl alcohol were quite high.

In their study of the wood-heel industry, Elkins and Hemeon [71] supervised a survey of 13 of the 41 establishments engaged in the wood heel-covering business. Air analysis in 8 of the 13 plants yielded the following average methyl alcohol concentrations: plant (1), 780 ppm (1,020 mg/cu m); plant (2), 475 ppm (622 mg/cu m); plant (3), 365 ppm (478 mg/cu m); plant (4), 320 ppm (419 mg/cu m); plant (5), 210 ppm (275 mg/cu m); plant (6), 185 ppm (242 mg/cu m); plant (7), 180 ppm (236 mg/cu m); plant (8), 160 ppm (209 mg/cu m). With the exception of plant (4) in which only one value was given the rest of the values were the average of 2 determinations.

In 1938, Greenburg et al [38] found airborne methyl alcohol concentrations of 22-25 ppm (29-33 mg/cu m) in well-ventilated rooms in which methyl alcohol was used to impregnate fused collars.

Goss and Vance, [72] in a survey of 5 plants using duplicating machines reported the following average airborne methyl alcohol concentrations: plant (1), 367 ppm (480 mg/cu m); plant (2), 45 ppm (57 mg/cu m); plant (3), 572 ppm (749 mg/cu m); plant (5), 206 ppm (270 mg/cu m); and 260, 93, and 165 ppm (340, 122, and 216 mg/cu m, respectively) in 3 different departments of plant (4). Samples of duplicating fluids used were reported to contain between 45 and 85% methyl alcohol in plants (2) through (5).

Leaf and Zatman [30] investigated atmospheric conditions in a methyl alcohol-manufacturing plant. The sampling was done in 3 distinct plant areas: the synthesis plant, the distillation plant, and the stripping plant. In the synthesis plant, where the operations were completely enclosed (high-pressure manufacturing process), no methyl alcohol was found (less than 5 ppm). In the distillation plant, the air samples taken near the sampling tray, the most likely place for an accumulation of vapor in the distillation area, contained 40-64 ppm (54-84 mg/cu m) of methyl alcohol. In the stripping plant, the airborne methyl alcohol concentrations were 80, 82, and 116 ppm (105, 108, and 152 mg/cu m, respectively).

McAllister, [73] also in a study of airborne methyl alcohol concentrations around 4 different makes of duplicating machines, reported average breathing zone concentrations that ranged from 400 to 800 ppm (524-1,050 mg/cu m). Moreover, general room air concentrations were as high as 1,000 ppm (1,300 mg/cu m). Although not clearly stated by the author, his report would indicate that these high concentrations occurred because the room was small and had poor ventilation. Subsequent sampling in a well-ventilated office with only 3 machines in operation was carried out and breathing zone samples showed methyl alcohol concentrations ranging from 155-420 ppm (200-550 mg/cu m). Air concentrations of methyl alcohol 10 feet from the machines decreased to 65 ppm (85 mg/cu m).

Dutkiewicz and Blockowicz [74] performed field studies in one of a number of plants manufacturing emulsifying agents (lanoceryt, euceryt) and the raw material used in their chemical synthesis, namely cholesterol. Methyl alcohol was used in various stages of a multistage manufacturing process. Airborne concentrations of methyl alcohol were determined at all stages of the process and at least twice at each worksite. Air samples were collected at hourly intervals during the entire work shift or for the duration of any one particular process. Average airborne concentrations were found to range from 45 mg/cu m (34 ppm) to 1,100 mg/cu m (840 ppm) depending on the worksite. In this particular plant, the worksites were not stationary and the workers were consequently exposed to various concentrations of airborne methyl alcohol for varying periods of time.

Control of Exposure

Engineering design and work practices for operations with methyl alcohol should have as their main objectives controlling vapor concentrations, minimizing skin and eye contact, and preventing fires.

Closed systems, properly operated and maintained, should be used where practicable to achieve all 3 objectives. Where closed systems are not feasible local exhaust systems and temperature control can be used to control methyl alcohol exposures. [75,76] It is preferable to control methyl alcohol vapor at the source, rather than by general dilution ventilation. Specific operations in which methyl alcohol is used in aerosol form, such as spraying methyl alcohol-containing materials like lacquers or varnishes, may require additional precautions. These precautions may include correct placement of exhaust hoods and air movers. Exhaust air should not be recirculated or discharged into the atmosphere in such a manner that it may reenter the work area. Guidance for the design and operation of ventilation systems can be found in _Industrial Ventilation--A Manual of Recommended Practice_ [77] or revisions thereto, and in _Fundamentals Governing the Design and Operation of Local Exhaust Systems Z9.2-1971_. [78] Sparkproof equipment should be used in all areas in which the possibility of ignition exists. Although respiratory protective equipment is not an acceptable substitute for proper engineering controls, it should be available for emergency purposes and for nonroutine maintenance and repair.

Protective clothing should be worn whenever repeated or prolonged skin contact may occur. [76] Eye protection should be used in areas where splashing of methyl alcohol is possible. [76]

Although methyl alcohol is a liquid at normal air temperature, it is sufficiently volatile to create hazardous vapor concentrations in confined spaces. The vapor is flammable and will burn in open air. The lower explosive or flammability limit is approximately 6.7% or 67,000 ppm. [4]

Structures and operations should be designed to minimize the amount of methyl alcohol that may become airborne, for example, by the installation of appropriate local ventilation, thus reducing the possibility of fires. All areas in which methyl alcohol is stored should be well ventilated. Storage of large volumes of methyl alcohol should be remote from inhabited buildings or structures. [76]

V. DEVELOPMENT OF STANDARD

Basis for Previous Standards

In 1940, Bowditch et al [79] published the _Code for Safe Concentrations of Certain Common Toxic Substances Used in Industry_. These safety limits were used to some extent in Massachusetts as a guide to manufacturers and others interested in maintaining satisfactory working conditions. The maximum allowable concentration (MAC) for methyl alcohol was given as 200 ppm (260 mg/cu m). [79] No basis for this recommended value was furnished.

In 1945, Cook [80] reviewed the MAC's of industrial atmospheric contaminants as promulgated by a number of states (California, Connecticut, Massachusetts, New York, Oregon, and Utah), the US Public Health Service (USPHS), and the American Standards Association, now known as the American National Standards Institute (ANSI). Oregon had a MAC of 100 ppm (130 mg/cu m) for methyl alcohol. Utah's limits were 100-200 ppm (130-260 mg/cu m). The other 4 states, USPHS, and American Standards Association gave the MAC as 200 ppm (260 mg/cu m). Cook [80] also recommended a limit of 200 ppm (260 mg/cu m). The basis for this recommendation was the work of Sayers et al, [41] who observed no toxic signs or unusual behavior in 4 dogs exposed to methyl alcohol vapor at a concentration of 450-500 ppm (590-650 mg/cu m) for 8 hours daily (7 days/week) for 379 days.

ANSI's [2] acceptable concentrations for methyl alcohol in 1971 were: 200 ppm (260 mg/cu m) as an 8-hour TWA concentration limit, a ceiling concentration of 600 ppm (785 mg/cu m) for an 8-hour workday, 5-day workweek, if the TWA limit was at, or below, 200 ppm, and a maximum peak concentration of 1,000 ppm (1,300 mg/cu m) for a duration of not more than 30 minutes if encountered not more than once a day. If such peaks occurred, they were to be taken into consideration in maintaining the overall TWA concentration. Recommendations were "based upon the present state of human experience and animal investigation"; however, the specific citations were not given other than the AIHA Hygienic Guide Series published in 1957 [81] for methyl alcohol for the peak concentration.

The most recent (1971) documentation of the methyl alcohol TLV's [82] explained the basis for the TLV of 200 ppm (called a MAC), first recommended in 1946; Cook [80] was cited in support of this TLV. It was the opinion of the TLV committee [82] that the 200-ppm value "incorporates a fairly large margin of safety against serious toxic effects." In the 1974 TLV Documentation, [83] the limit for methyl alcohol was still listed at 200 ppm (260 mg/cu m) with a "Skin" designation, which is intended to suggest the need to prevent skin contact or absorption, or that such absorption should be considered in evaluating exposures.

The current federal worker exposure standard for methyl alcohol is 200 ppm (260 mg/cu m) as a TWA concentration limit (29 CFR 1910.1000), based on the 1968 ACGIH recommendation for a TLV, which was documented in 1971. [82]

A survey [84] of occupational limits that have been set by foreign countries shows a wide variation in recommendations. In 1974, the Federal Republic of Germany had a standard of 260 mg/cu m (200 ppm); in 1973, the German Democratic Republic had a standard of 100 mg/cu m (76.4 ppm); in 1973, Sweden had a standard of 280 mg/cu m (214 ppm); in 1969, Czechoslovakia had a standard of 100 mg/cu m (76.4 ppm). In 1959 the USSR standard was 50 mg/cu m (38.2 ppm) as a maximum permissible concentration. [85] A more recent (1972) survey [14] listed the USSR standard as 5 mg/cu m (3.8 ppm) as a ceiling. [84] The reference [84] indicates that with the exception of the USSR, the rest of the values listed for the other countries were for an 8-hour TWA.

The 1969 Documentation of MAC in Czechoslovakia [86] cited the work of Greenburg et al, [38] Sayers et al, [41] Elkins, [87] and Cook. [80] The Czechoslovakia MAC Committee did not consider the work of Sayers [41] applicable for toxicity in humans, particularly for effects on the optic nerve.

Basis for the Recommended Environmental Standard

Epidemiologic studies incorporating comprehensive environmental surveys, well-planned surveillance, a sufficient study population, and statistical analysis have not been found in the literature. It is therefore difficult to recommend an environmental limit based upon unequivocal scientific data.

Numerous effects including dizziness, [13,19,40] nausea and vomiting, [17,40] visual disturbances of various types, [17,40] acidosis, [19,40] and headache [14,16,17,39,40] have been reported following exposure to methyl alcohol by ingestion, inhalation, and percutaneous absorption. Many of these previously enumerated effects are not unique to methyl alcohol intoxication, as they can be caused by a wide range of other chemical and physical stresses. The signs and symptoms most characteristic of methyl alcohol poisoning in humans are various visual disturbances [14,16,17,19,25] and metabolic acidosis. [19,40] The relationship between acidosis and visual disturbances may or may not be one of cause-and-effect, as was demonstrated in the study of Bennett et al [40] in which patients with and without acidosis complained of visual disturbances.

The characteristic asymptomatic latent period between ingestion of methyl alcohol and the development of toxic manifestations lends some support for the hypothesis that the metabolic products of methyl alcohol are the proximal toxic agent(s). In addition, toxic manifestations can be attenuated by the administration of ethyl alcohol, [29] a compound which has been shown to inhibit the metabolism of methyl alcohol in vivo. [30,31,37]

Direct skin contact with methyl alcohol has been reported to cause dermatitis [14,27,71] although there appears to be a marked individual variability in susceptibility.

Direct contact of methyl alcohol with the eyes is said to result in chemosis and superficial lesions of the cornea which are rarely of a serious nature. [24] This conclusion is supported by the finding that methyl alcohol is a mild eye irritant in rabbit eye tests. [50]

While not clearly documented, there appears to be a wide range of individual variability among subjects exposed to methyl alcohol by inhalation, percutaneous absorption, and ingestion. Wood [18] described the cases of 4 men who were employed together as varnishers of beer vats and thereby exposed to methyl alcohol both by inhalation and by percutaneous absorption. One man complained of dizziness after the first day and could not continue work after the second day. Another did not develop symptoms until the third day. The remaining two worked through the third day but subsequently died without returning to work. This variability can be seen more clearly in the cases of 2 men observed by Bennett et al [40] in which one individual died after ingesting approximately 15 ml of a 40% methyl alcohol solution while another survived after ingesting 500 ml of the same solution. This wide variability in individual susceptibility to ingested methyl alcohol has also been noted by others. [11,44]

Humperdinck [25] has reported one case in which a worker suffered diminution of vision at airborne methyl alcohol concentrations ranging from 1,600 to 10,900 mg/cu m (1,200-8,300 ppm). Leaf and Zatman [30] showed that in human volunteers airborne concentrations of methyl alcohol from 650 to 1,430 mg/cu m (500-1,100 ppm) could only be tolerated for 3 to 4 hours. The authors [30] did not define intolerable conditions. Kinsley and Hirsch [39] reported that airborne methyl alcohol concentrations ranging from 15 ppm (20 mg/cu m) to 375 ppm (490 mg/cu m) caused severe recurrent headaches. As the authors stated, the concentration to which the workers were probably exposed was always in excess of 200 ppm with a peak concentration of 375 ppm. The New York Department of Labor bulletin [14] reported dermatitis of the inflammatory type, anemia, nearsightedness, and conjunctivitis at airborne methyl alcohol concentrations of 200 ppm (260 mg/cu m). There is, however, little evidence that anemia and nearsightedness were attributable to methyl alcohol exposure. In addition, the relationships between the effects described and the airborne concentrations reported are of doubtful significance as previously discussed in Chapter III. Greenburg et al [38] reported that no adverse health effects were seen at airborne methyl alcohol concentrations of 22-25 ppm (29-33 mg/cu m).

Chao Chen-Tsi [22] and Ubaydullayev [23] reported that airborne concentrations around 3.3-3.5 mg/cu m (2.5-2.7 ppm) caused a diminution of light sensitivity and that this effect was not seen at 2.4-3.1 mg/cu m (1.8-2.4 ppm). Additionally, Ubadullayev showed that all 6 human subjects tested at an airborne methyl alcohol concentration of 1.46 mg/cu m (1.1 ppm) showed changes in alpha-rhythm amplitude as measured on an EEG, whereas 1.0 mg/cu m (0.77 ppm) did not elicit this response. As previously discussed (see Chapter III), the relative importance of these effects is questionable in standard setting.

The wide range of estimates of the odor threshold for methyl alcohol can be clearly seen from 2 sets of studies estimating the odor threshold for methyl alcohol, Scherberger et al [20] reporting 1,500 ppm and May [21] giving 5,900 ppm (while citing 2,000 ppm as the figure suggested by the Dragerwerk Company of Lubeck) and, in marked contrast to these, Chao Chen-Tsi [22] giving 3.3-8.5 ppm and Ubaydullayev [23] giving 3.4 ppm as the minimal perceptible concentration of methyl alcohol by odor. It is difficult to reconcile such wide differences, even allowing for different experimental techniques. Small traces of impurities can have a very marked effect upon odor, but in the absence of any data in any of these 4 papers on the source or purity of the methyl alcohol used, the issue of impurities is only a matter for conjecture.

No information has been found to warrant a modification of the existing federal TWA limit for exposure to methyl alcohol of 200 ppm (approximately 260 mg/cu m). In particular, no comprehensive epidemiologic studies or other significant data on the inhalation of pure methyl alcohol vapor have been found. Most of the human inhalation studies reported involve other airborne organic compounds as well as methyl alcohol. Hence, no valid dose-response relationships concerning the inhalation of methyl alcohol vapors can presently be established. Therefore, there is no justification for changing the current TWA environmental limit of 200 ppm (approximately 260 mg/cu m) for methyl alcohol. Since the adverse effects of methyl alcohol are primarily related to its action on the central nervous system, it is possible that exposure to high airborne concentrations for brief periods may sufficiently affect attention, judgment, or perception so that, if an emergency were to occur, the worker might not take appropriate action. This suggests the need for a ceiling concentration to be observed, as a limitation on excursions above the TWA and as a limit applicable to occasional and brief use of methyl alcohol. However, after detailed consideration of the data applicable to derivation of such a ceiling, no basis from the scientific data appears. Thus, a ceiling limit of 800 ppm (1048 mg/cu m) based on a 15-minute sampling period is proposed on the basis of good practice.

It is recognized that many workers handle small amounts of methyl alcohol or work in situations where, regardless of the amount used, there is only negligible contact with the substance. Under these conditions, it should not be necessary to comply with many of the provisions of this recommended standard, which has been prepared primarily to protect workers' health under more hazardous circumstances. Concern for the workers' health requires that protective measures be instituted below the enforceable limit to ensure that exposures stay below that limit. For these reasons, the action level for methyl alcohol has been defined as worker exposure at or above half the TWA environmental limit, thereby delineating those work situations which require the expenditure of health resources, of environmental and medical monitoring, and associated recordkeeping. Half the TWA environmental limit has been chosen on the basis of professional judgment rather than on quantitative data that delineate nonhazardous areas from areas in which a hazard may exist. However, because of nonrespiratory hazards such as those resulting from skin or eye contact or from ingestion, it is recommended that appropriate work practices and protective measures be required regardless of the air concentration.

VI. WORK PRACTICES

Work practices germane to the safe handling of methyl alcohol are the subject of several thorough documents [3,76]; however, reports of work practices specifically designed for the prevention of low level exposure to methyl alcohol have not been found. In general, the primary goal of good engineering controls and work practices should be to maintain vapor concentrations below prescribed limits, to minimize excursions and eye and skin contact, and to prevent fires.

The flash point of methyl alcohol is 54 F (12 C) [3]; it is therefore designated as a flammable liquid of Class IB in 29 CFR 1910.106 (19)(ii). The lower and upper explosive limits for methyl alcohol in air at 20 C are 6.7% and 36.5% by volume. [4] Different values for the lower explosive limit have been reported and found to range from 6.0%, as reported in the Hygienic Guide for Methyl Alcohol, [88] to 7.3% given by the Manufacturing Chemists' Association. [3] Hence, fire and explosion are significant hazards associated with the storage, handling, and use of methyl alcohol. The recommended work practices are intended to ensure that no flames or other sources of ignition such as lighted smoking materials are permitted in the area where methyl alcohol is stored or handled. An acceptable margin of safety for flammable substances is 10% of the lower explosive limit (29 CFR 1917.11(a)(2) and 29 CFR 1915.11(a)(2)). Therefore, precautions against fire and explosion hazards must be taken to ensure that airborne methyl alcohol concentrations do not accumulate to, or exceed, 0.67% (6,700 ppm). Special precautions are necessary for entering vessels which may contain methyl alcohol [3] and for flame- and spark-generating operations, such as welding, cutting, smoking, and transferring methyl alcohol. [89,90]

Ingestion of methyl alcohol can cause serious poisoning resulting in death or blindness. [11,40] In order to prevent the worker from accidentally ingesting methyl alcohol, it is essential that all containers in which methyl alcohol is kept must be properly labeled as to content, hazard, and possible health consequences if consumed. Additionally, the consumption or storage of food or beverages should not be permitted in the workplace in accordance with provisions of 29 CFR 1910.141 (g)(2) and (g)(4).

While airborne levels of methyl alcohol can be maintained below limits that are injurious to the health and safety of the workers by engineering controls, [77,78] certain situations such as spills, equipment failure or maintenance, vessel entry, etc, can occur which require special respiratory protection. The selection of the proper respiratory devices is presented in Chapter I.

Although methyl alcohol is not a primary skin irritant, prolonged or repeated contact with the liquid has produced dermatitis in a few people. [14] A greater hazard than dermatitis is severe poisoning that may occur from skin absorption of methyl alcohol, reported by Gimenez et al [27] in children. While protective clothing is normally not required, if it is needed to prevent contamination from methyl alcohol splashes or prolonged skin contact, it should be impervious to methyl alcohol. [3,76] If methyl alcohol is splashed on clothing, the methyl alcohol should be immediately washed off and the garment thoroughly dried before reuse. [3] Additionally, any affected areas of the body (except the eyes) must be washed thoroughly with soap and water and a change of clothing provided. [3,90] The employer may wish to provide protective clothing of a fire-retardant nature, even though it is not required.

Chemosis and lesions of the corneal surface have resulted from methyl alcohol splashed in the eyes. [24] Depending on the nature of the operation, eye protection in the form of goggles or face shields should be used to protect against methyl alcohol coming in contact with the eyes. [3,91,29 CFR 1910.133] If methyl alcohol comes in contact with the eyes, they should be immediately flushed with copious amounts of water, and the patient should be examined by a physician. [76]

In summary, precautions should be exercised against fire and explosion hazards of methyl alcohol. Additionally, precautions should be taken to prevent the serious consequences from methyl alcohol due to ingestion, inhalation, or skin or eye contact. It is important that workers be informed of the hazards associated with methyl alcohol before job placement and whenever changes are made in any process that may alter their exposure. Flammability and appropriate procedures should be stressed. Appropriate posters and labels should be displayed. The US Department of Labor form OSHA-20, "Material Safety Data Sheet," or a similar OSHA-approved form, should be filled out. All employees in the methyl alcohol exposure area should know where the safety sheet is posted. Safety showers, eyewash fountains, and fire extinguishers should be located in areas where methyl alcohol splashes are likely to occur and should be properly maintained. Handwashing facilities including soap and water should be available to employees.

The safe handling of methyl alcohol depends to a great extent upon the effectiveness of employee education, proper safety instructions, intelligent supervision, and the use of safe equipment. The education and training of employees to work safely and to use the personal protective equipment is the responsibility of management. Training classes for both new and current employees should be conducted periodically to maintain a high degree of safety in handling procedures. [3]