MATHEMATICAL MODELING OF DISPERSION OF AIR POLLUTANTS FROM INDUSTRIAL STORAGE TANKS

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Abstract: Air Pollutants are emitted into the atmosphere due to accidental spillages from storage tanks and are mixed thoroughly with the surrounding air and get diluted by Atmospheric Dispersion. Dispersion is the spreading of the pollutants from a source in all the directions. As such pollutants occupy larger and larger volumes of air through dispersal they get diluted in the atmosphere. Estimation of the concentrations of such pollutants at different distances from the source is important for determining the ambient air quality and this process is known as Air Pollution Modeling. Such modeling is based on analytical, mathematical, statistical and simulation studies. Analytical modeling mainly depends on Gaussian model which has several limitations and hence is seldom realized in practice. Hence there is a need to develop improved models to represent the field conditions. Hence the present work is an attempt to study the existing air quality models considering the variations in the density of the pollutant. In the present study the gradual leakages and accidental leakages of ammonia from an industrial storage tank is considered for the modeling. In the event of vessel failure the contents would leak and form a cloud of ammonia, whose characteristics would strongly depend on several factors like pressure in the tank, size of leakage opening, storage as well as ambient temperatures, storage mode, rates of release and wind velocity etc. The main objective of this work is to study (i) the different dispersion patterns of accidentally released dense gases and (ii) the variation of average discharge rate, duration of discharge, toxic vapour dispersion analysis for various discharge hole diameters for both non-pressurized tanks containing liquid and pressurized tanks containing gas and/or liquid using ARCHIE and ALOHA softwares. For this study a 5000 tonne ammonia storage tank used in a local fertilizer plant at Visakhapatnam is considered for the modeling studies. The model studies will be used to predict the ground level concentrations of ammonia at different distances from the plant for estimating the population likely to be adversely affected due to the sudden release of ammonia and their consequent dispersion in the neighborhood of the plant under different meteorological conditions. These results will be useful to the local authorities and the government for the preparation of the emergency evacuation plans and for conducting the mock drills for ensuring safety of the people in case a maximum credible accident were to occur due to an earthquake, extreme floods, airplane crash or bombing due to terrorist activates.