

FIFTH SESSION - DISCUSSION

STATIC ELECTRICITY: ACCEPTABLE RISK

THE PRINCIPLE OF ACCEPTABLE RISK.

by Dr T. Gadian (Lankro Chemicals Ltd).

and

THE DEVELOPMENT AND APPLICATION OF QUANTITATIVE RISK CRITERIA FOR CHEMICAL PROCESSES.

by Mr B.C. Bulloch (I.C.I. Ltd, Mond Division).

Dr D.H. Napier (Imperial College, Dept. of Chemical Engineering):

What general basis do you recommend for deducing a value for a life? For example, safety expenditure, what the product will stand, magnitude of cost awards? Is this value calculated with hindsight of safety expenditure, etc. averaged out over the last 4 or 5 years?

Mr Bulloch:

By calculating the risk before some safety expenditure is carried out and calculating the risk afterwards one can arrive at the implied value of a life.

We are being predictive. Taking as an example petrol road tankers - there is a reasonable statistical basis for saying how often people die in fires following road accidents in which petrol tanker barrels split open. What we would do would be to say we could reduce that risk by making the tanker barrels thicker.

If we propose a certain increase in barrel thickness we know how much it would cost to modify the tanker fleet and we can express this as an annual cost. We can predict the likely reduction in the frequency with which barrels will split in accidents, and we therefore know how many lives we are going to save annually. We can therefore calculate the implied value of a life.

Dr R. Williamson (Humphreys & Glasgow):

Dr Gadian listed the precautions taken in the Dyestuffs Industry and mentioned frequent urine monitoring.

(1) What is the procedure if aromatic amines are detected, thus confirming exposure?

(2) Is there any evidence that single exposures can ultimately produce bladder tumours?

Dr Gadian:

If we find that a man has a fairly high amine content in his urine, his working conditions in general are unsatisfactory, and so we would try to find out if it is the fault of the individual, or if there is a leak in the plant. Bladder tumours do not arise from a single exposure. It is only through repeated exposure that tumours may arise over a period of months or years.

Mr J.R. Stirzaker (I.C.I. Ltd, Organics Division):

Dr Gadian in his paper makes the point about what the sensationalist press can do with emotive subjects. There is another area in similar context, namely the Trade Unions who are becoming increasingly involved in industrial injuries and all that implies. What the Unions' attitudes to the principle of acceptable risks and the equating of life and limb against the value of plants and machinery, etc.

Dr Gadian:

The T.U.C. is guided in medical matters by its Medical Officer, who takes a balanced view of all the circumstances, and the T.U.C. attitudes are in general fair and realistic.

Mr J.A. Dukes (U.K.A.E.A.):

Examining potential accidents which have not happened yet can be more rewarding than studying those which have. There are fewer distorting emotional overtones, and a better subjective and quantitative judgement is usually possible. It can be particularly effective in the continuous improvement of plant design.

One may persuade people with insight, people of plant experience, to identify the hazards they can foresee. By asking the right authorities, these hazards can be assessed as to probable accident frequency and likely accident severity. I could do no better than to enlist the interest of our U.K.A.E.A. Safety and Reliability Directorate.

One may thereby build up a picture of the "Acceptable Norm" - based on practice. For example, the rule might be  $\log(\text{frequency, year}^{-1}) = 3 - \log(\text{£ cost TDC})$ .

The principle of the "Acceptable Risk" is now gaining credibility. I suggest we turn attention to the practice of that principle. It is an interesting experiment to promulgate these ideas, at Board level and at Shop Steward Convenor level simultaneously.

Mr B.H. Hampson (Unilever Research Laboratory):

All the risk figures in the example in Mr Bulloch's paper are based on judgement or experiment and, in my estimation, it will take between 200 and 2,000 years before we know whether they are right or not.

Mr Bulloch:

With this sort of calculation it is impossible to say that the frequency you have ultimately predicted is borne out by practice. However, if you consider the simple primary events which must coincide before a hazard arises, for example an instrument or a gas supply failing, these generally occur sufficiently frequently to be checked from experience. Thus by keeping records we can check the figures which we have used for the frequencies of the primary events in the fault tree, and if there is good agreement, we can have reasonable confidence in our prediction or hazard frequency.

GENERATION OF STATIC ELECTRICITY IN STEAM SCREENS AND WATER CURTAINS.  
by Dr D.H. Napier (Imperial College, Dept. of Chemical Engineering).

Mr K.N. Palmer (Building Research Establishment):

- (1) Mention was made of jet geometry in the steam jet work. Is any information available on performances of circular and slit jets?
- (2) Are aerosol dispensers, with combustible propellants, likely to give incendive conditions?

Dr Napier:

(1) The reference to jet geometry was in relation to the effect of the length/diameter ratio (L/D). As L/D increased the charge produced increased. With the small jets used in the work reported, there was little difference between the results from a circular and a 'slit' orifice. The results obtained from varying L/D indicate that charge separation at the wall of the jet is important, so that the perimeter/area ratio of the orifice will be of some significance.

(2) If the dimensions of the aerosol cloud and droplets are suitable, energy could be produced in the cloud equivalent to the ignition energy. Ignition will not be direct, the necessity arises to collect the energy from the aerosol, e.g. on an insulated conductor, in order to produce an incendive spark. The probability of collecting sufficient charge, of poor grounding of the collector and of producing an incendive discharge appear to be low for the commonly-encountered size of aerosol dispenser.

Dr W.D. Rees (BP Research Centre, Sunbury-on-Thames):

For the water atomiser, is the charge on the droplet generated in the pipeline or by the breakup of the charged polarised filament emanating from the atomiser?

Dr Napier:

I have no direct evidence to offer on this point, but in view of the design of the atomiser and the turbulence created in it, it seems likely that a major part of the charge is produced by filament rupture.

-----

Since the Symposium Mr E.S. Hunt of I.C.I. Ltd, Petrochemicals Division has sent us a written contribution on static electricity in steam jets. Lack of space prevents us from publishing this in full, but it carried the following conclusions.

The simple holes drilled in 'Fire Curtain' steam pipes do not cause excessive static electrification of the vapour cloud, but the jets **MUST NOT** be played on any close objects (1 foot) or the electrification may be greatly increased.

Potentials of many Kilovolts can be produced on objects in the cloud, but the currents available are small and with normal leakage these potentials will not develop. If, however, the object is very well insulated and has sufficient capacitance, incendive discharges can be produced.

If an earthed conductor is obstructing the jet, the static electrification is greatly increased and the system must be considered no longer safe.