

Using Fire Foam on Ammonia Spills

Tests in English chemical plant show new type of fire extinguishing foam material is effective in reducing evaporation of the ammonia

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Certain types of fire-fighting foam compounds can be very effective in suppressing evaporation of ammonia from spills. Tests at the Billingham, England, plant of Imperial Chemical Industries Ltd. have shown that a specific type of foam, based on a synthetic detergent can be very satisfactory.

The most common type of foam used for hydrocarbon fires is based on waste protein matter and contains a large amount of water. If this is applied to a pool of ammonia it causes an increase in boiling and is thus worse than useless. This was reported at the 1974 AIChE symposium on ammonia safety.

The specific brand of foam which succeeded in trade-named "Komet Extrackt S," and it can be generated at various expansion ratios. At high ratios, the foam is very light and tends to be blown away; therefore, the expansion ratio used as 75:1.

Two tests have been carried out, using trays 5 ft. by 2 ft. 6 in. and 8 ft. by 6 ft. 6 in., both 9 in. deep, into which cold liquid ammonia was fed to a depth of 4½ in. This came to 258 lb. of ammonia liquid in the small tray and 885 lb. in the large tray. The trays were insulated at the bottom and sides with polyurethane.

Ammonia was run in and allowed to equilibrate with no covering for 45 minutes. Synthetic foam was then allowed to roll over the tray with the results summarized in Table 1. Average meteorological conditions are given in Table 2.

Evaporation rate from the small tray was 1.25 lb./sq. ft./hr. when not covered. Temperature of the ammonia was -72°C. After 3 to 4 in. of foam had been put over the ammonia, no weight loss was measured in 30 minutes, and human beings could lean over the tray without face masks. There was little deterioration of the foam in that time period.

From the large tray, the free evaporation rate was 0.5 lb./sq. ft./hr. After being sprayed with foam, it was again possible to lean over the tray without a mask. Ammonia



Figure 1. Foam on ammonia spill tests in progress.

concentrations downwind before application of the foam were rather less than expected, but when foam was applied there was a major reduction.

A small test was also carried out with a protein-based foam of higher water content, to confirm that this type of foam was indeed quite unsuitable.

The ammonia was finally disposed of by spraying water on both trays, producing gross evaporation.

The tests show that the "synthetic" foam can be valuable for this situation, but that other types are worse than useless. We have not had the occasion to use foam on a spill of anhydrous ammonia as yet. However, some months ago, a pump pit was flooded with ammonia liquor and the vapor release was such as to cause management to contemplate evacuation of the main canteen. The Komet Extrackt S foam was applied, and it suppressed the evaporation so well, it was possible to pump out and to cover the ammonia liquor at leisure. #

	Test	
	Small tray	Large tray
Wind, miles/hr.	8	3
Wet bulb temp., °C	12	12.8
Dry bulb temp., °C	14	14
Dry bulb temp., °F	58	58
Humidity, %	78	85

Table 1. Ammonia concentration, ppm. v/v (maximum at cross-line)

	Distance from tray, ft.		
	20	50	100
<i>Small tray:</i>			
Free evaporation	250	40	15
Komet Extrackt S	25	1	1
Water spray	2,000	50	10
<i>Large tray:</i>			
Free evaporation	1,000	100	75
Komet Extrackt S	40	20	10

Table 2. Meteorological data, averaged

DISCUSSION

K. FEIND, BASF, Germany: Because we wanted also to be so quickly like the ICI, we followed a discussion in September 74 in Salt Lake. We tested the behavior of different types of fire fighting foams covering a 6 sq. meters large liquid ammonia pool. The pool volume was 500 liters of liquid anhydrous ammonia. We found also that the fire fighting foam type "Komet Extract S" was rather resistant against liquid ammonia. This foam has a content of three weight percent foam liquor, and 97 weight percent of water.

It was sprayed out through a nozzle with 400 liters per minute liquid, and with a ratio of liquid to air, 1 to 75. In the beginning of the test, the thickness of the foam layer covering the ammonia pool was 30 centimeters. 18 hours later, without any attack of wind, the thickness of the foam layer was about 3 centimeters. But by a rain during some hours of this test time, there was an ammonia water mixture of 0.6 kilograms ammonia to 1 kg water.

A second test with a first layer of expanded polystyrene spheres two to three mm diameter, covering the liquid ammonia, and a second layer of this foam covering then the layer of the expanded polystyrene failed, because the polystyrene spheres were swimming upon the foam and both together are very dependent on the wind conditions—the foam more than the polystyrene spheres.

JAN BLANKEN, UKF-Holland: I understand that you put the foam on the ammonia when the temperature of the ammonia was -70°C .

Now on the assumption that the foam layer brings the partial pressure of the ammonia up to 1 atmosphere, because it avoids the dilution effects of the air, you have what I would like to call a heat sink from minus 70°C to minus 33°C .

Did either Dr. Feind or ICI measure the temperature of the pool immediately after putting on the foam in order to get an idea of say the heat of reaction between foam and ammonia.

This would give an idea of the ammonia released to atmosphere when spraying foam on a pool still having a temperature of -33°C .

CLARK: That's a perfectly valid point. I don't know the answer but I'm going to find out something about it. I don't know whether the people here are quite clear about it. Everybody thinks, at least I always thought, that anhydrous ammonia left to itself goes down to a temperature of minus 33°C and it won't go any lower. However, that's not true. It goes down to minus 33 if the partial pressure of ammonia above the pool is 1 atmosphere, but if you are blowing the ammonia vapour away with air, it will go down and down and minus 70°C minus 80°C is quite possible.

Now as Mr. Blanken has said, if you let the pool evaporate freely, the ammonia will go down to minus 70°C . If you then blanket it with foam, you are holding the ammonia against the surface of the pool, the partial pressure of the ammonia gas above the pool is then one atmosphere, and the pool won't evaporate until it's warmed up to minus 33°C . How long will that take to happen? Some sums could be done on the basis of the free evaporation rate measured in these tests to find out how long it would take to come up to minus 33°C , at which temperature it could then start boiling again.

One interesting point which I have been told may interest you, is that the protein foam is quite good on liquid chlorine. You are not so worried there about reaction with water generating heat and causing boiling. If you drop liquid chlorine on the floor, any kind of foam is better than nothing.

CLARK: (communication after the meeting) Calculation of the time taken for the ammonia to warm up from -70°C to -33°C , based on the heat inleak which caused the observed rate of evaporation of ammonia from the pool without any foam cover, suggests that the pool had probably not warmed up to -33°C during the time that the observations were taken. The effect of covering with foam may therefore give only a temporary benefit which nevertheless can be very valuable.