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How our scientists helped avoid ‘Bhopal 2'

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AP GETTING GOING: The team quickly set up facilities to examine how the MIC was manufactured and stored, what led to “the event”, and how to get rid of the methyl Isocynate from tank 611.

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Much has been written about the recent judgment in the Bhopal gas tragedy. But the role that our scientists and engineers played, on the spot, during the catastrophic period has not been duly brought out. It was nothing less than heroic. Let us see why and how.

Toxic gases leaked out at the Union Carbide factory in Bhopal from a stainless steel tank containing 42 tons of liquid methyl isocyanate (MIC), in the wee hours of 3 December 1984. MIC was stored in two such tanks (each containing 42 tons) since October 1984, and one of them leaked (tank no. 610) on the fateful night. The other (611) fortunately did not, but what if it too leaked?

Two problems

The MIC in it had to be somehow safely disposed. Thus the problems were two: one was understand what led to the leakage and what all toxic material leaked out; and two, learning from this, how to safely dispose the MIC off the other tank.

The accompanying, equally major question was: what were the effects of the toxic gases on the people around — how and why did they cause death and damage, and how can such damage be countered or avoided. Thus, one aspect was chemical and engineering related while the other pathology and treatment related.

Let us take one by one; first the chemistry and storage conditions.

MIC boils at 80°C but does evaporate at lower temperatures. It is thus best stored refrigerated (below 10°C).

This was not done at Bhopal during those days. While ultrapure MIC can be inert, trace impurities set up a chain reaction. One of them produces**a** solid polymer which can clog up pipes through which MIC is transferred from the storage tank.

Another reaction occurs when water comes into contact and reacts with MIC, generating heat; this in turn causes MIC to react further, generating more toxic material. The heat also releases

trace amounts of materials (that contaminate or accumulate in stainless steel vessels, or connecting pipes) which lead to further runaway reactions. The questions thus were: did water somehow enter tank 610 through leakage, did a chain of toxic chemicals arise, and why did MIC leak out copiously into the atmosphere.

Dr. S Varadarajan, who was the Secretary of the Government of India Department Science & Technology, rushed to the site at Bhopal soon after the tragedy, he inspected the site and the tanks, obtained the inputs from the Carbide people, obtained manuals and protocols, and decided to look into the residues still left in tank 610, in order to get an idea of what all could have happened to the MIC. Importantly, these would give a lead on what could be done to safely dispose the MIC off tank 611, which too had about the same 40 tons of MIC.

In order to do so, he put together a team of chemical engineers and related experts — namely Dr. L.K. Doraiswamy, N.R Ayyangar, C.S.P Iyer, A .A Khan, A.K. Lahiri, K.V. Muzamdar, R.A Mashelkar, R.B Mitra , O.G.B Nambiar, V.Ramachandran, V.D Sahasrabuddhe, S. Sivaram, M. Sriram, G. Thyagarajan and R.S. Venkataraman.

Quick action

This team of 16 quickly set up the facilities to examine how MIC was manufactured and stored at Bhopal, what led to “the event”, and how to get rid of the MIC from tank 611. The story of how they did this, through “Operation Faith” is a proud one. What did they find and do?

What did they find? One: The factory cut corners in the name of economy.

Rather than store MIC in a series or batch of small, easier handled tanks, they used huge ones.

Two: The tanks were not kept refrigerated, but at ambient temperature. Three:

The caustic soda in the accumulator (used to emergency- dump MIC) was grossly insufficient. Four: Analyses of the residual material in 610 revealed as many as 12 different products of MIC reactions. Five: The escape valve and the scrubber used to treat gases exiting the vent did not work well, if at all.

In short, conditions ripe for the initiation of a runaway reaction existed already in tank 610 well before the event. And as much as 500 kg of water could have entered the tank that night, very likely through vent header pipes. Back up of water in these lines released metal contaminants, making matters more violent. What did they do next, about the potential bomb stored in tank no. 611? Here the team showed its true grit. Learning from the detailed analysis of the 610 tragedy, they put forward a crisis management protocol.

This included devising methods to prevent any leakage, precautions to be taken to minimize damage, providing information to the government on steps to be taken to minimize effects of potential toxic gases, and offer authentic information to the press and public continuously to avoid confusion and panic. They then set up the task of handling 611. The best thing to do was — to make the final product, Sevin, for which MIC was stored in the first place.

Dr. Varadarajan termed this exercise as “Operation Faith”. The process of converting 21 tons of MIC from 611, one ton from tank 619 and material form a number of drums into Sevin, at the rate 3-4 tons daily started on Sunday December 16th, 1984 and ended six days later. Thus was a second ‘Bhopal' avoided.

We tend to complain and cavil about our colleagues when things go wrong. Here was crisis management and forestalling at its best, at the darkest hour in Indian's recent history. Let us appreciate and applaud those, even if 26 years after. We shall turn to the other heroes, Drs. S. Sriramachari and Heeresh Chandra, who handled the medical part of the event in the next article.

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