METHANOL PLANT EXPLOSION

Rupture of oil blowdown line allowed compressor synthesis loop to depressure in a reverse flow direction; explosion damage was extensive; production resumed in 10 days

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The Escambia Chemical methanol plant commenced operation in April, 1958. The plant was of conventional design, utilizing natural gas, steam, and carbon dioxide as raw materials. The plant was constructed directly adjacent to the ammonia plant, which was completed in early 1956. The compressors of both ammonia and methanol are housed in one long compressor building.

On the morning of October 24, 1965, at 6:30 a rupture of an oil blowdown line from a high pressure filter occurred which allowed the complete compressor synthesis loop to depressure in a reverse flow direction. It is estimated that approximately 10 to 20 seconds' delay occured after the failure before ignition of the escaping gas resulted. The explosion damage was extensive. The repairs to the plant were completed within about 8 days, and full production resumed in 10 days.

We were exceedingly fortunate in that no one was seriously hurt. The few casualties were mainly from flying glass in surrounding buildings some distance away from the compressor building.

I will discuss for you the fire-fighting phase and what we learned from this experience, the sequence of events in making repairs in approximately 8 days, the changes that were made to provide greater protection for personnel and to minimize the damage of any future fires.

Assessment of damage

We were very fortunate that no one was seriously injured by the fire and explosion. We were also fortunate that the explosion occurred at shift change when there were approximately twice as many operating and maintenance people available to fight a fire of this nature. It is estimated that fire water from three sources was on the fire area within 2-5 minutes of the time of the explosion. Fire protection in the area was from QAR stations. Operating personnel reacted promptly in blocking in the fuel supply to the plant and isolating the flammables feeding this area as rapidly as possible. The ammonia plant operation, which is adjacent to the methanol operation, was shut down but was restarted after several hours when an assessment of damages indicated this could be safely done.

The prompt availability of water in addition to minimizing damage from the flames served to keep structural support members cool and also to keep vessels cool. The heat from the fire damaged all of the electrical wiring and instrument wiring or tubing to the high pressure synthesis area to the west of the compressor building. All control valves in this area suffered damage to the top works and had to be repaired.

It was felt that the rapid depressuring of the converter in the reverse direction, plus the fact that all temperature indication in the converter had been lost during the fire, required replacement of the converter catalyst. This was done during the period in which the plant was repaired and put back on stream.

Damage inside the compressor building was extensive but fortunately other than the control room itself, was not particularly major. The rotor of the 700 hp electric motor drive for one of the circulators was damaged but could be repaired within the time the rest of the repair work was completed. It was possible to make repairs to most of the control room instruments or to find suitable replacement instruments from plant spares.

The combination explosion and implosion which followed caused damage at a distance up to 600-800 feet away from the compressor building. The few personnel who were injured were most seriously injured in the control laboratory at a distance of perhaps 300 feet where flying glass caused cuts on laboratory technicians.

Repairing the damage

Cleanup and repairs were commenced as soon as the inspection of the plant indicated it was safe. The organization of the repair work was handled by Escambia's Construction and Design group. Maintenance handled converter repairs with the compressor personnel handling inspection and repairs there.

Temporary protection was provided over certain items of equipment and removal of hanging pieces of transite was commenced from the top of the building utilizing iron workers. Cleanup was fairly complete by 9:00 Sunday evening. Temporary lighting was provided for the area and reconstruction was carried out on a 24-hour basis. It was early recognized that the most critical areas would probably be instruments and electrical equipment which showed fire damage, so that teams of pipefitters and instrument mechanics removed all of the damaged control valves and instruments from the plant to a shop area Sunday night. By Monday morning, October 25, it was possible to place orders for repair parts for instruments and for new instruments where required. By late Monday a critical path had been developed which indicated that probably the repairs could be completed within 8 days if the continuing inspection of equipment indicated no major long delivery items damaged.

One of the major projects was to assemble the spare converter basket with a new catalyst charge; since the catalyst in service had only been installed a few days earlier, the spare basket had not been prepared for recharging. It was decided to remove the existing basket to dump the catalyst and to prepare a new charge.

Many vendors of instruments and other suppliers did a tremendous job in responding to our emergency need.

Changes which were made

The extensive damage which resulted to the methanol control

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room, which was of relatively light construction with large glassed areas, caused us to completely rebuild the panel of heavier construction with a minimum of glass areas. Much of the changes in the control room design have also been made in other operating areas in the plant which were damaged by the explosion. For example, the windows in the laboratory control buildings have been eliminated. Large glassed areas in the ammonia-methanol gas preparation control buildings have been eliminated. Replacement of all glass in windows with plastic or laminated safety glass has been accelerated throughout the operating areas. As a standard practice, no glass other than safety glass is used in any of the operating areas.

With regard to fire fighting facilities, Escambia is in the process of installing additional turret nozzles to protect potentially hazardous areas in methanol-ammonia and other plants to provide quick cooling fire water. Our experience with QAR or reel stations indicates that in an emergency, there is a delay in getting the reel station functioning. A turret nozzle can be actuated by one man and approached behind a water shield to direct the water within seconds where needed. We have found that the availability of a turret nozzle to quickly cool an area where fire has started will minimize damage to instruments and electrical, or a turret nozzle stream directed on a leak will prevent a fire, and allow prompt control.

The changes made to the control rooms generally follow the practice of eliminating large window areas and providing reinforced steel and concrete walls rather than block construction.

In conclusion, we would like to thank the various equipment vendors who helped us to resume production so rapidly, and we also give full credit to our operating and maintenance people whose prompt action minimized the damage.

Discussion

Q. What was the cause of the failure?

Dorsey: It was a valve and I'm not at liberty to go beyond this point. This valve, when it failed, allowed full 1 in. flow of hydrogen-carbon monoxide gas at 5,000 lb./sq.in. gauge pressure out into the atmosphere which just exploded when it reached a source of ignition.

Q. Was this a matter of corrosion?

Dorsey: No, there was no corrosion here.

Q. Could you tell us what kind of over-pressure your control room which you rebuilt inside the compressor building will stand?

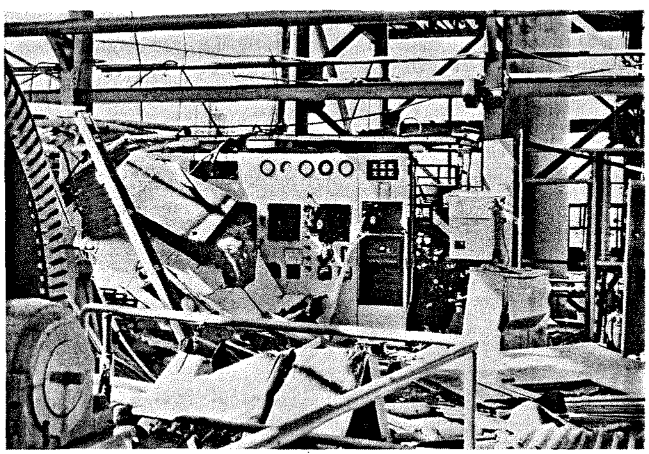

Figure 1. All control valves in this area suffered damage to the top works.

Was there a design basis for over-pressure?

Dorsey: No, there was not. Our feeling was that we would leave the doors free to swing either way and we built this strong enough of steel such that it would yield, and the effort was to protect an operator who was inside from fragments of transite. Our thought was not to contain an explosion inside. It was not built to withstand heavy projectiles - it is built of 1/8 in. plate on the outside and 1/8 in. plate on the inside, with insulation in between and with a 4 channel section to which this plate is attached. There was no effort made to design it to resist internal or external pressure.

Q. You mentioned also your new control houses. As I understand, these are now poured concrete. Is this correct?

Dorsey: Yes. What has been done is to design around available pre-stressed concrete T's. The T's have been put vertical as the sidewalls, and across the top for the roof. When the sidewalls are put in place, the reinforcing steel in these T's is welded to the reinforcing steel in the floor, and in the roof. Then the floor, and roof cornice is poured, so that the building has a steel interlock between the roof, sidewalls, and the floor, reinforced with the concrete. The result is a complete integral unit. The building was insulated and air conditioned. The windows are small and narrow.

Q. Can you tell us what kind of over-pressures these buildings will stand?

Dorsey: I can't. The first one of this type put into service in 1963 and it was tested by resisting a severe explosion. I can't tell you what the design pressure is but I think it was one worked out. This design was developed with the Southern Prestressed Concrete Company who have offices and plants throughout the southeast. It was a joint effort with their design people and our own to arrive at something that was better than the typical block construction control room.

Q. One last big question. Can you tell us the size of your windows and the type of glazing which you used?

Dorsey: In the way we rebuilt the windows?

Q. I was thinking primarily of your control houses.

Dorsey: The windows were 12 in. wide by 3 ft. long.

Q. And the glazing material?

Dorsey: It is laminated safety glass 1/4 in. thick. These incidentally will blow out as a unit but usually by the time they blow out, they have lost most of the energy and they will fall to the ground inside.

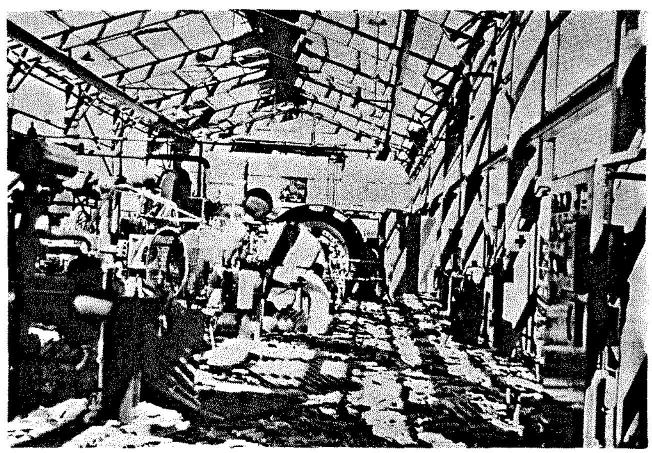

Figure 2. Heat from the fire damaged all of the electrical wiring and instrument wiring or tubing.