

L. G. MATTHEWS
Linde Co.

Oxygen plant explosion

Hydrocarbon concentrations in main condenser believed cause of detonation.

AN EXPLOSION IN THE No. 1 unit of Linde's on-site oxygen plant serving DuPont at Belle, West Virginia, occurred at about 2:20 p.m. on April 20, 1960. The flash resulted in destruction of the main condenser (reboiler) and a portion of a fractionating column. Externally, an insulation silo was severely damaged, and there was some damage to the transite-sheathed building housing the operating panels

and compressors. Except for the condenser and column of the No. 1 unit, damage to production equipment was not extensive. There was no damage to the No. 2 unit, though the flash in No. 1 resulted in its shutdown. The No. 2 unit was withheld from service until after a complete check.

Eleven employees, who were inside the building, received minor injuries and were treated at the plant

dispensary and released. A twelfth employee, who was outside the building, received the most exposure and was hospital-treated for minor burns. He was back at work the following morning.

Cause of explosion

It has been concluded that this flash was probably caused by concentration of a quantity of hydrocarbon material in the main condenser. The identity of the exact hydrocarbon or hydrocarbons involved has not been ascertained, nor has the mechanism of ignition been pin-pointed. The concentration of hydrocarbon material in the condenser was probably due to impaired circulation between the condenser and a silica gel trap, designed to keep the hydrocarbon concentration in the condenser at an acceptable level.



L. G. Matthews has been employed with Union Carbide since receiving B.S.Ch.E. from Purdue Univ. in 1935. From 1935 to 1950 he has been active in the field of production and distribution of compressed gases, particularly acetylene. In 1950 he transferred to Linde's Safety Codes Department, became Assistant Manager in 1953, and Manager in 1958. He has been active in many organizations including A.I.Ch.E. ACS, CGA, ASA, American Welding Society, American Society of Safety Engineers, International Acetylene Assoc.

Normal total hydrocarbons (around 30 ppm) and C_2H_2 (less than 0.2 ppm) were indicated in the condenser liquid just before the flash. It is agreed, however, that these analyses of condenser liquid are not representative of concentrations which could be reached in localized areas of the condenser passages with impaired circulation. Samples taken and analyzed after the flash showed nothing unusual.

All operations had been smooth and normal, and no unusual atmospheric conditions were noted. Air contamination surveys had been run prior to plant erection, and checks were run at intervals during operation. After the flash, new surveys failed to disclose any unusual situations. With minor exceptions, only CH_4 was detectable, and it varied from 2.5 to 3.0 ppm with occasional peaks at 5.0 ppm.

The No. 1 unit had been in satisfactory operation for over 10 years at the time of the occurrence. At the time of the explosion, it had been in operation 72 days since its last thaw. Some two years before the incident, the unit had been enlarged and fitted for high purity N_2 production.

The rebuilt No. 1 unit was put back in service about three months after the date of the flash. In the rebuilding, a recirculation pump was included in the main condenser and silica gel trap assembly. #

Questions and answers

ANONYMOUS: Did you put in a cold end gel trap as part of the revisions to this plant?

L. G. MATTHEWS: When this plant was rebuilt after the flash, we put in cold end and side bleed gel traps.

ANONYMOUS: Did you say that you checked for hydrocarbons normally during operation and did you find any contamination prior to the flash?

MATTHEWS: As I recall, a check for

C_2H_2 was made approximately two hours before the flash with negative results. Hydrocarbons in the condenser are monitored on a continuous basis. They were indicated to be around 30 ppm total hydrocarbons.

ANONYMOUS: What do you consider an acceptable maximum in that particular operation?

MATTHEWS: I do not recall at the moment, but I think the shut down point on that plant is either 100 or 200 ppm total hydrocarbons.

BOLLEN—Dow Chemical of Canada, Sarnia, Ont.: This discussion brings to mind a near miss at our plant due to high C_2H_2 concentration. Just prior to this occurrence we had shut down the air plant for a period of 4 or 5 hours as we have done several times in the past. On these occasions we do not dump the liquid O_2 but try to complete whatever work necessitated the shutdown and get back on stream as quickly as possible.

The shutdown occurred on Friday and we did not analyze for C_2H_2 again until the following Monday morning. Analyzing by the Los Vey

reagent method, we got a heavy black precipitate. Since it was not the permanganate color usually associated with C_2H_2 there was some question as to whether it was really C_2H_2 or whether something else was interfering with the analysis. The analysis was repeated with the same result. Consultation with more experienced people convinced us that the precipitate was due to C_2H_2 and the black color indicated quantities in excess of 15 to 20 ppm. We promptly shut down the plant and dumped the liquid O_2 .

We believe that during the start up we may have desorbed C_2H_2 from the rich-liquid filters and swept it into our vaporizer section. It raises the question as to whether even short shut downs should be undertaken without dumping the liquid O_2 .

WEIGERS—American Cyanamid Co., New Orleans, La.: If we shut down and stay cold, *i.e.*, retain our liquid, we make it a practice of starting up with a fresh adsorber each time, because we're afraid of this desorption phenomenon.

S. F. BOHLKEN
N. V. Mekog (Holland)

Heat exchanger explosion at a nitrogen-wash unit

Stringent safety requirements are vital when considering hazards of the oxides of nitrogen.

AN UNEXPECTED EXPLOSION IN THE VICINITY of the -130° to $-145^\circ C$ section of the second heat exchanger at the Mekog nitrogen-wash unit occurred on July 13, 1959, causing severe damage. The explosion occurred while the unit was working under full load after being in normal service for 42 days. Prior to this, the unit had been completely thawed and washed with caustic solution. Despite the great damage, there were fortunately no personnel injuries.

Process under consideration

The normal process in the production unit concerned is as follows: A gaseous mixture is obtained by partial oxidation of fuel oil using steam and O_2 . Soot is removed by scrubbing with H_2O , the gas is then purified of sul-

fur compounds by means of scrubbing at 17 atm. abs., after which the CO is converted.

A volume of 17,000 cu. m. of gas at 1 atm. and $15^\circ C$ is then passed to a H_2O scrubbing circuit (Figure 1) where CO_2 is removed. The quantity of H_2O used is 1900 cu. m./hr., the quantity of make-up H_2O every 24 hr. is about 40% of the H_2O inventory. The gas is subsequently washed with caustic solution after which 10,500 standard cu. m. of gas/hr. remains.

The gas thus obtained contains 0.1% of O_2 , less than 5 ppm of unsaturated hydrocarbons (mainly C_2H_4), and 0.1 to 0.5 ppm of NO, while C_2H_2 and dienes are only present in traces (less than 0.01 ppm of each). This gas passes into the nitrogen-wash unit