Interoffice Communication

To D. H. Sanders

From K. G. McLeod

Date April 15, 1976

Subject PVC Reactor Opening Losses

The proposed EPA standard on vinyl chloride monomer emission from PVC plants regulates reactor opening losses to 0.001 pound VCM per 100 pounds PVC. Reactor opening losses are VCM atmospheric emissions due to VCM left in the reactor volume during and following slurry dump. They are determined by measured reactor VCM concentrations following reactor dump. Process Engineering Department and Aberdeen plant engineering jointly conducted a plant test to determine the reactor opening losses (reactor VCM concentrations) following dump at current steam stripping conditions and to determine a viable method of reducing reactor opening loss to the regulated value.

The proposed EPA standard reactor opening loss limit of 0.001 pound VCM per 100 pounds PVC is equivalent to a reactor vapor space concentration of around 1,000 ppm VCM (volume). This report speaks to VCM concentrations rather than VCM emission/PVC product weight ratios.

Results and Conclusions

1. VCM concentration in the reactor atmosphere following dump is 1 to 4 percent at current 225°F steam stripping conditions.

2. Steam stripping the reactor during dump reduced reactor atmosphere VCM concentrations to 1,000-4,000 ppm.

3. Steam stripping the reactor during dump followed by a two- to five-minute evacuation reduced reactor atmosphere VCM concentrations to 500 ppm. This represents a viable method of achieving compliance with the proposed EPA reactor opening loss regulation.

4. Maintaining a positive reactor pressure (1 to 6 psig) during dump caused no operational problems. Steam leakage at the dump Sweco was minimal. Reactor vibration was not significantly different from normal steam stripping.

Discussion

PED and Aberdeen plant engineering departments jointly conducted a series of tests at the Aberdeen PVC Plant. These tests were to develop a viable method of reducing the reactor atmosphere to less than 1,000 ppm VCM in order to bring reactor opening losses in compliance with proposed EPA regulations.

The two primary approaches used to reduce VCM in the reactor atmosphere were evacuation and steam purging during dump. Both methods were used individually and in combination with each other. Steam purge following dump and rinse was not attempted due to possible corrosion problems.

Eleven test batches were run on D-300 and D-400. Gas and slurry sample results for each batch are presented in Tables I and II.

All batches were recovered and steam stripped per the normal plant operating procedure. Run No. 0 was dumped and rinsed at atmospheric pressure with the atmospheric vent open. Runs Nos. 1 through 4 were dumped and rinsed in the same manner as run No. 0. The steam jet ejectors were then used to evacuate the reactor, and the vacuum was broken with air through the four-inch atmospheric vent. Test results show all four batches were consistently below 1,000 ppm VCM in the reactor atmosphere following evacuation. Evacuation took ten minutes to reach 28.6 inches of Hg vacuum--approximately the same amount of time required for evacuation prior to charge.

Run No. 5 was dumped and rinsed under steam pressure. All vents and recovery lines were kept closed while sufficient steam was added through the steam stripping nozzle to maintain reactor pressure between 2 and 5 psig. Following rinse, the ejectors were used to evacuate the reactor (approximately six minutes to reach 28.6 inches of Hg vacuum). This batch showed that VCM concentration gradients can occur in the reactor.

Runs Nos. 6 through 8 were dumped and rinsed while the reactor was being purged with steam. The evacuation steam jet ejectors were used to withdraw a constant vapor volume, and steam was added through the steam stripping nozzle to maintain reactor pressure between 2 and 5 psig. Following rinse, the reactor was blocked in and cooled to less than 150°F. The resulting vacuum was broken through the four-inch atmospheric vent. This method did not consistently reduce VCM in the reactor atmosphere to less than 1,000 ppm. Runs Nos. 7 and 8 show VCM concentrations ranging from 1,000 to 4,000 ppm. This indicates that steam purging during dump and rinse reduces the reactor VCM concentration by 80 percent to 90 percent.

Runs Nos. 9 and 10 were dumped and rinsed while purging the reactor with steam. Once the rinse water was drained, the reactor was evacuated. Run No. 9 reached a final reactor pressure of 29.0 inches of Hg vacuum after two minutes of evacuation with full cooling water on the condenser and jacket. Run No. 10 was evacuated for three minutes without cooling water and for an additional two minutes with cooling water. Final pressure was 29.3 inches of Hg vacuum.

The method of operation used in run No. 10 is presented in Table III.

All reactor atmosphere samples for runs Nos. 9 and 10 are below 400 ppm VCM with the exception of one sample at 900 ppm VCM.

Reactor atmosphere samples were collected in gas bags using Bendix gas sampling pumps and nylon instrument air tubing. Runs Nos. 0 through 3 were sampled using a single Bendix pump and tube. Samples were taken from approximately fifteen feet below the top manway and six inches away from the reactor wall. The reactor agitator was running during sampling to provide some degree of mixing of the vapors.

Sampling for runs Nos. 4 through 10 was accomplished using three separate pumps and tubes so that top, middle, and bottom samples were collected simultaneously. Tube inlets were spaced ten feet apart, and sampling was completed with the top tube inlet located approximately one foot below the top manway and two feet away from the reactor wall. The method used in collecting samples for these runs was to lower the sampling tubes into the reactor and start the pumps. The outlet of the bottom pump and tube was monitored with a Century gas analyzer; and when the Century showed a steady reading, the middle and top outlets were checked and values recorded. Gas bag samples were collected, and readings were taken again with the Century unit. A duplicate set of gas bag samples were collected and a final set of Century values recorded. Total sampling time was approximately fifteen minutes.

Slurry samples were collected in a one-quart dipper. An eye dropper was used to transfer slurry from the dipper into the sample vial. This is the standard method used in the Aberdeen plant. The results indicate some sampling bias, in that runs 5-7 and runs 8-10 were collected by two different persons. Ending slurry analyses are probably most affected by proximity to end of dump.

Rinse water samples were collected using the slurry sample collection method.

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RAF:RAD:DEM:RTF
WFR:PFF:DLH:ELK

Approved by:

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