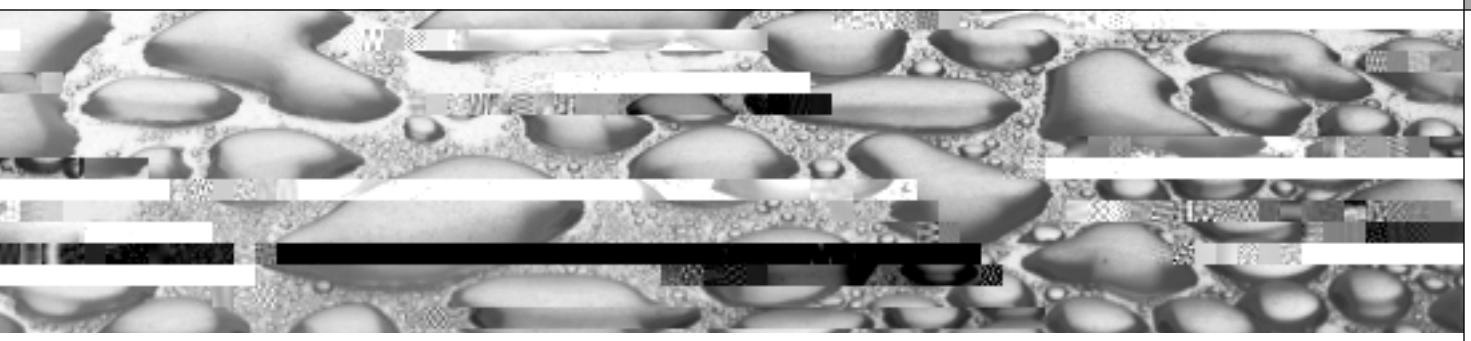

By J.R. Lines and A.E. Smith

Condensation is one technology used to reduce volatile organic compound (VOC) emission rates. Its use has been driven in part by

chloride is 85 lb/lb-mole and has a vapor pressure of 3.24 psia at 40°F. Water vapor has a molecular weight of 18 lb/lb-mole and a vapor pressure of 0.122 psia at 40°F. Methylene chloride and water are immiscible.

VOC condensation is dependent on non-condensible gas mass flowrate and molecular weight, operating temperature, oper0.0l nkr6ut1F(0lecul6u)-5.Et1ec2 of

Freeze condensation

The heat transfer characteristics of the condenser are different from conventional applications. A frost or ice layer often builds up continuously on the heat transfer surface. This continued buildup of product on the heat transfer surface tends to impede heat transfer, with the buildup acting as an insulator, and the pressure drop increasing across the condenser.

Normally, pressure drop rises faster than outlet temperature increases. To ensure reliable VOC reclamation, two freeze condensers are used. One is operating while the other waits on standby. As operation progresses, inlet pressure to the operating condenser is sensed. As operating pressure increases above a preset value, a set of automatic control valves switches flow to the standby unit. Pressure rises in the operating unit because ice forms, reducing cross-sectional flow area. That unit needs to undergo defrosting so it will be ready to return to reclamation operation.

Another important aspect of freeze condenser design is gas/vapor velocity. Velocity must be maintained relatively low to avoid entrainment of droplets or buoyant snowflake-like material. Velocity concerns exist for conventional condensers as well.

To achieve deposition or required reclamation levels, the use of a cryogen as a cooling media is becoming commonplace. A typical cryogen is liquid nitrogen at -275°F to -300°F. To conserve nitrogen consumption, it is vaporized and superheated within the condenser. Here again, thermal design takes on a new level of sophistication. The temperature differentials result in suppression of the boiling coefficient because it is in the film-boiling regime instead of the preferable nucleate regime. The excessive temperature gradient induces pressure fluctuations or surg-