Polyvinyl chloride (PVC) is the third-most widely produced polymer in the world after polyethylene and polypropylene. Popular because of its chemical resistance and mechanical strength, PVC can be manufactured in rigid and flexible forms and is used in a wide range of products. Consequently, global demand for PVC is high.

There are two routes to manufacturing PVC: the ethylene-based route has become the predominant application, but the acetylene-based route has advantages: e.g. in China, approximately 60 percent of VCM capacity is acetylene based due to a shortage of ethylene cracker feedstock.

PVC manufacture is achieved through the production of Ethylene Dichloride (EDC) and Vinyl Chloride Monomer (VCM), which are intermediate products with no direct applications.

VCM is produced by reacting acetylene with hydrogen chloride. VCM is mixed with water in the presence of polyvinyl alcohol, lauryl peroxide or isopropyl per carbonate, where a catalytic reaction takes place. After a few hours this produces PVC granules, which can be moulded to form many commercial products.

Servomex is an expert in the supply of analyzers and systems designed to meet the requirements of both EDC and VCM processes. We offer an industry-leading range of analyzer solutions for EDC/VCM gas and liquid analysis that overcome common process problems including condensation, corrosion and gas absorbence issues.

Supported by a global network of Service and Support, our expertise in both EDC and VCM production enables Servomex to consult, design and build systems that are safe, reliable and highly productive.
ETHYLENE DICHLORIDE PROCESS APPLICATION MAP

ETHYLENE PROCESS

A SERVOTOUGH SpectraExact 2500 measures the 0-100% ethylene (C₂H₄) stream into the chlorination reactors (1). The oxygen (O₂) measurement is critical: efficiency drops if too little O₂ is present, but too much O₂ can create an explosive mixture in the reactor. For maximum process safety, multiple SERVOTOUGH OxyExact process O₂ oxygen analyzers in a safety voting system are used (2).

The crude EDC stream, monitored by a SpectraExact (3), is sent to the clean-up fractionator to produce pure Ethylene Dichloride (EDC), where the production of light ends require another SpectraExact to measure 0-10% sodium hydroxide (NaOH) following caustic scrubbing (4). Large amounts of Hydrogen Chloride (HCl), EDC and residual water can increase corrosion damage, so an H₂O measurement in the EDC stream is critical (5), (7). Pyrolysis requires a SERVOTOUGH FluegasExact 2700 to monitor O₂ and COe combustibles for maximum combustion efficiency (6), before the combined Vinyl Chloride and HCl stream is quenched and sent to a splitter. As VCM is flammable, O₂ incursion in the product is measured by a SERVOTOUGH Oxy 1900 (8) to eliminate flammability risks when it is sent to storage or PVC manufacture. The HCl gas recycled from the stripper needs to be high purity, so a SpectraExact (9) and SERVOTOUGH LaserExact 2950 (10) are used to measure 0–100% and 0-1000ppm HCl respectively for optimum reactor control.

The HCl stream is fed back into an Oxychlorination reactor, where the SpectraExact measures the incoming crude C₂H₄ stream (11) and an OxyExact monitors the incoming O₂ stream (12). 0-10% O₂ is also monitored by an OxyExact as the crude EDC stream is fed back into the process (13). Often the VCM content of the HCl re-cycle feed is monitored (14).
ACETYLENE PROCESS (CALCIUM CARBIDE)

Hydrogen (H₂) and Chlorine (Cl₂) are created from the electrolysis of brine, with the SERVOTOUGH LaserSP 2930 (1) measuring ppm moisture in the Cl₂ stream, to avoid corrosion in the compressor, and SERVOPRO MonoExact 5522 (2) monitoring % levels in the H₂ stream.

The H₂ and Cl₂ are reacted to make HCl, which has safety measurements for 90-100% HCl (3) and ppm Cl₂ (4) made by the SpectraExact. The HCl is then combined with acetylene (C₂H₂) to produce VCM. Either an OxyExact or Laser 3 Plus can be used for measuring % oxygen levels both in the C₂H₂ stream (5) and, once the VCM is reacted, and sent to the PVC polymerization process (6), a %O₂ safety measurement is made using either an OxyExact or Laser 3 Plus (6).