

Catalytic Ammoxidation of o-Xylene to Phthalonitrile in Vapour Phase

P.N. Tiwari ^{(1)*}, Priyank Maheshwari ⁽¹⁾ and Jitendra Kumar Gupta ⁽¹⁾

(1) Chemical Engineering and Technology Department, Institute of Technology,
Banaras Hindu University, Varanasi, India, email- pntiwari.che@gmail.com

Abstract

Ammoxidation is defined as oxidation of a methyl group in the presence of NH₃ and oxygen under the influence of a suitable catalyst leading to the formation of a nitrile group.



Where R represents Aryl, Vinyl or Allyl group

Production of phthalonitrile from catalytic ammoxidation of o-Xylene has been gaining importance due to increased demand of phthalonitrile in the aerospace industry for the design of totally fire resistant cabins for spacecrafts as it has the ability to survive elevated temperature exposure up to 371°C and polymers based on the phthalonitrile have good thermal and oxidative stability.

In course of present study vapour phase ammoxidation of o-Xylene was carried out in thermal gradient less fixed bed reactor at atmospheric pressure in presence of vanadium chromium oxide catalyst (prepared by impregnation technique) of various concentrations supported on silica and analyzed the effects of temperature, molar ratios of ammonia/o-Xylene and oxygen/o-Xylene, and catalyst concentration on the activity and selectivity of catalyst to form phthalonitrile

Structure of catalysts has been found rhombohedral by X-Ray diffraction. FT-IR spectra of catalysts showed bands in region 1100-900 cm⁻¹ arising from silicates vibration, the bands between 950-900 cm⁻¹ are due to Cr₂O₇²⁻ vibration, bands between 800-785 cm⁻¹ are because of VO₃²⁻ vibration and bands between 470-460 cm⁻¹ attributed to SiO₃²⁻ vibration. BET surface area data shows that surface area of the catalysts decrease with increasing the loading of active gradient over silica support and drastic change in surface area was found as loading increase to 10% from 5% and the best suitable process conditions found were as follows: temperature = 450 °C as above 450°C the formation of other products like CO₂, CO etc starts and at the same time the yield of phthalonitrile decreases, molar ratio of ammonia/ o-Xylene = 30 and oxygen/o-Xylene = 50, and the optimum catalyst concentration = 7%. The results have the significant impact on the production of phthalonitrile from o-Xylene.

