Effect of carrier characters on poisoning of environmental total oxidation Pt/γ-Al_2O_3 catalysts by Organo Silica Compounds

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Abstract

Environmental laws limit and press the industries to control the emission of Volatile Organic Compounds (VOC) around the world. Total catalytic oxidation is a suitable technology for removing and control of VOC in industries, but poisons, like Organic Silica Compounds, deactivate these catalysts. In this paper, this problem is investigated over Pt/γ-Al_2O_3 catalyst with emphasis on Organic Silica Compounds as poison. The effect of catalyst carrier has been investigated and the reversibility phenomenon has been researched in this poisoning process too.

Keywords: VOC; Organic Silica Compounds; Pt/γ-Al_2O_3; Catalyst carrier; reversible and irreversible poisoning

1. Introduction:

Organo silica compounds are used in different industries like printing, oil industries, and mining as lubricant and polishes oil, and domestic applications like silicon rubber and aerosol sprays [1, 2], because of their special physical properties, like viscosity [1] and dielectric constant [3]. But this group of compounds has poisoning effects on different catalytic reactors and domestic applications, such as atmospheric scrubbers, automobile exhausts, flammable gas detectors [4], hydrotreating (HDT) process [5], and naphtha reforming [6]. There are a few reports and paper about deactivation effects of these compounds over catalysts.

Gentry and Jones [7] investigated deactivation of different catalytic media, like filaments and pellets. They diactivated platinum wires (filaments), Pt/Al_2O_3, Pd/Al_2O_3, Pt/SiO_2, Pd/SiO_2, Pt/13X zeolite (Linde), and Pd/13X zeolite by hexamethyldisiloxane (HMDSO) in oxidation reaction of methane, carbon monoxide, propene, and hydrogen. Their results showed that HMDSO had an irreversible poisoning effect on oxidation reaction of methane at 873K. It had partly reversible effect in oxidation of carbon monoxide over Pt/Al_2O_3, Pd/Al_2O_3, Pd/SiO_2, Pt/13X, and Pd/13X, but had an irreversible effect over Pt/SiO_2 catalyst at 523K. Also, they showed that deactivation of Pt/Al_2O_3 catalyst by HMDSO, in oxidation reaction of propene, was partly reversible, but deactivation was negligible in case of hydrogen oxidation at 873K [7].

Cullis and Willatt [4] deactivated the Pd/SnO_2 (pellets) and powders of Pt/Al_2O_3 and Pd/SnO_2 catalysts in oxidation reaction of methane at 650K and Pt/(Al_2O_3+ThO_2) in oxidation reaction of methane at 650-800K and butane at 800K by HMDSO. They showed that the deactivation of powder catalysts was completely reversible in methane oxidation. They also showed that the deactivation of Pd/SnO_2 catalyst in methane oxidation and Pt/(Al_2O_3+ThO_2) catalyst in butane oxidation reaction were partly reversible, and the deactivation of Pt/(Al_2O_3+ThO_2) catalyst in oxidation reaction of methane was completely irreversible [4].

Ehrhardt et al. [1] investigated the effect of HMDSO on oxidation of methane over self-supported platinum ribbons at the temperature range of 700-1100. Their results showed that deactivation of platinum ribbons were partly