

HYDROGENATION OF AROMATIC NITRO COMPOUNDS TO AMINES ON NICKEL AND IRON-CONTAINING CATALYSTS

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ABSTRACT

A special place among the chemical transformations of nitro compounds is the reduction reaction allowing the production of valuable amines. In this review, the focus is on the discussion of nickel and iron-containing catalysts. Nickel is the most common catalyst for the reduction of various substances, including nitro compounds. Along with Raney nickel different nickel-based catalysts are used: nickel black, Ni/Al₂O₃, Ni/C, Ni/kieselguhr, Ni/SiO₂, Ni/ZnO, Ni/MgO, Ni-Cr₂O₃/C. Today iron-containing catalysts are successfully used in various processes (Fischer-Tropsch synthesis, Gaber-Bosch, dehydrogenation, dechlorination of organochlorine compounds) and during last years the papers devoted to the application of Fe-containing catalysts for selective catalytic reduction of nitro compounds have been published. The application of catalytic systems based on Fe and Fe_xO_y nanoparticles for implementation of the selective hydrogenation of nitro groups is a promising decision for replacing expensive catalysts prepared of Pt-group metals.

Keywords: Liquid-phase Hydrogenation, Aromatic Nitro Compounds, Aromatic Amines, Nickel, Iron.

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INTRODUCTION

A huge range of amines can be obtained from nitro compounds through the reduction reaction of nitro groups. Amines have wide application in the production of various dyes, drugs, corrosion inhibitors, stabilizers, polyurethanes, antiknock additives for gasoline and motor fuels.¹⁻³ Hydrogenation of aromatic nitro compounds is carried out in the liquid or gas phase and in either case, heterogeneous catalysis is used.⁴⁻⁸ Many hydrogenation processes go through several intermediate stages and the hydrogenation of aromatic nitro compounds is no exception. Thus, upon the reduction of nitrobenzene in the reaction mixture, a different amount of azobenzene is detected.⁸ Possibly with a lack of hydrogen on the surface of the catalyst, nitrobenzene displaces from the surface primary intermediate products - nitrosobenzene and phenylhydroxylamine, which, interacting with each other, form azobenzene. The increase in pressure increases the concentration of hydrogen on the surface of the catalyst and contributes to the complete reduction of nitrobenzene. With the further development of adverse reactions, hydrogenolysis of the organic compound may occur with the formation of undesirable degradation products. Hydrogenation of substituted nitrobenzenes proceeds by complex series-parallel schemes of chemical transformations.^{1-3,9} In some cases, inhibition of the reaction by the resulting hydrogenation products is possible.¹⁰⁻²¹