CHEMICAL ENGINEERING TRANSACTIONS
VOL. 81, 2020
A publication of AIDIC
The Italian Association of Chemical Engineering
Online at www.cetjournal.it
Guest Editors: Petar S. Varbanov, Qiuwang Wang, Min Zeng, Panos Seferlis, Ting Ma, Jiří J. Klemeš

ISBN 978-88-95608-79-2; **ISSN** 2283-9216
DOI: 10.3303/CET2081155

Oxide Ni-Cu Catalysts for the Purification of Exhaust Gases

Xuliang Zhang[a], Zauresh T. Zheksenbaeva[a,b], Rabiga O. Sarsenova[b,c], Svetlana A. Tungatarova[a,b,*], Tolkyn S. Baizhumanova[a,b], Sergey I. Zhevnitskiy[d]

[a]Al-Farabi Kazakh National University, 71 al-Farabi ave., Almaty, 050040, Kazakhstan
[b]D.V. Sokolsky Institute of Fuel, Catalysis and Electrochemistry, 142 Kunaev str., Almaty, 050010, Kazakhstan
[c]Abai Kazakh National Pedagogical University, 13 Dostyk ave., Almaty, 050010, Kazakhstan
[d]Taraz State University named after M.Kh. Dulaty, 60 Tole bi str., Taraz, Kazakhstan
tungatarova58@mail.ru

Currently, special attention is paid to the environmental friendliness of modern chemical industries. Significant volumes of volatile organic compounds are released into the air annually and harm the environment as well as human health. Industrial waste gas treatment is an important component in environmental protection. The catalytic purification of toxic compounds occupies a special place in minimizing the generated waste. Compositions based on noble metals, especially platinum, palladium and ruthenium, which are very expensive, are the best catalysts. The aim of this work is to create catalysts for the purification of gases that do not contain noble metals. The results of the development of low-cost selective multicomponent oxide catalysts based on Ni, Cu, and Cr supported on 2 % Ce/θ - Al_2O_3 for the purification of volatile organic compounds using toluene as an example are presented in the paper. It was found that the highest degree of toluene conversion (up to 98.8 %) is observed on a three-component Ni - Cu - Cr/2 % Ce/θ - Al_2O_3 catalyst with an optimal ratio of metals Ni : Cu : Cr = 1.0 : 3.0 : 0.1 at a temperature of 723 - 773 K.

1. Introduction

Chemical safety and sanitary protection of the air are very relevant in connection with the increase in harmful emissions of industrial enterprises, which have a strong toxic effect on the environment. Most chemical compounds (toluene, xylene, styrene, phenol, tricresol, mineral alcohols, CO), which adversely affect on living organisms and flora, are harmful toxic emissions from industrial enterprises. Developed countries and countries with economies in transition have to reduce or stabilize greenhouse gas emissions under the Paris agreement, adopted on December 12, 2015 and signed on April 22, 2016, in addition to the United Nations Framework Convention on Climate Change (UNFCCC) (Reckien et al., 2018). The content of harmful emissions above the maximum permissible concentration in industrial plants and atmospheric air in cities has a negative effect on living organisms, which leads to various diseases. It poses a threat to environmental safety (Jecha et al., 2013). Toluene, xylene and ethyl-benzene are major part of the solvents used in various industries, which are present in gaseous emissions (Brattoli et al., 2014). Toxic and adverse effect of harmful emissions on a living organisms can be traced on the example of toluene - a major component of toxic organic gaseous emissions that are present in the emissions of furniture, paint, cable, printing and other industries. For example, the inhalation of toluene with a concentration of 250 mg m^{-3} for 2 h leads to a decrease in heart rate, speech inpairment, and movement coordination (Zheksenbaeva et al., 2012). Prolonged inhalation of toluene, which is present in the composition of glue, varnishes, paints, causes neurotoxic deviations that lead to clinical consequences - hallucinations, somnolence, suicide attempts, visual disturbances and seizures.
Deep catalytic oxidation is the most economical method for cleaning of gases from the emissions of complex composition (Duplančić et al., 2017), which follow from the literature data (Popova et al., 2006) on the methods and apparatuses for neutralization of toxic emissions. Typically, the catalysts based on noble metals (Pt, Pd) (Tidahy et al., 2007), which have high activity (95 – 100 %) in complete oxidation of organic substances (Kim et al., 2013), are used mainly for cleaning of waste gas of industrial enterprises (Tong et al., 2019). Catalysts based on platinum group metals have high activity at low temperatures, durability, heat resistance and ability

Paper Received: 01/05/2020; Revised: 14/06/2020; Accepted: 18/06/2020
Please cite this article as: Zhang X., Zheksenbaeva Z.T., Sarsenova R.O., Tungatarova S.A., Baizhumanova T.S., Zhevnitskiy S.I., 2020, Oxide Ni-Cu Catalysts for the Purification of Exhaust Gases, Chemical Engineering Transactions, 81, 925-930 DOI:10.3303/CET2081155