International Journal of Automotive Technology, Vol. 21, No. 6, pp. 1401–1408 (2020)
DOI 10.1007/s12239–020–0132–6

Copyright © 2020 KSAE/ 118–07
pISSN 1229–9138/ eISSN 1976–3832

CHARACTERISTICS OF EXHAUST EMISSIONS CONVERSION OF COMMERCIAL CU- AND FE-SCR CATALYTS

Choong-kil Seo[1)*] and Kyung seok Lee[2)]

[1)] Department of Automotive & Mechanical Engineering, Howon University, Gunsan 54058, Korea
[2)]Automotive Research Center, Chonnam National University, Gwangju 61186, Korea

(Received 26 November 2019; Revised 23 February 2020; Accepted 20 March 2020)

ABSTRACT–The purpose of this study is to identify the performance of the SCR catalyst according to the thermal aging, coking and space velocity subjected for commercial catalysts (Cu- and Fe-SCR). The Cu-SCR (Fresh) catalyst showed 83 % of high NOx reduction rate in the low temperature of 200 ºC, and the performance window of NOx reduction rate was established widely in all temperature ranges. Fe-SCR (800 ºC 22hr) catalyst was slightly improved with the NOx reduction rate compared to the Fe-SCR (Fresh) catalyst, and this was due to the increase in the intensity of acid site due to the de-aluminization. Cu-SCR (0.1 g coking) catalyst reduced NOx reduction rate by about 20 ~ 40 % compared to the Fresh catalyst due to the clogging of the catalyst active site by the carbon. When carbon of 0.1 g was deposited on the Cu- and Fe-SCR catalysts, it was reduced to NOx conversion rate because metal was deposited on active site of the SCR catalyst. In the effect of the space velocity of Cu-SCR (Fresh) catalysts, SV 44,000 h^{-1} and 56,000 h^{-1} reduced NOx conversion rate by about 15 ~ 40 % at the overall temperature compared to 28,000 h^{-1}. The larger the SV, the time for the exhaust gas to react with the catalysts is shortened. For SV 40,000 h^{-1} and 56,000 h^{-1}, NOx conversion rate was equivalent.

KEY WORDS : Diesel Engine, NOx, Lean NOx Trap, SCR, Coking, Space Velocity

1. INTRODUCTION

Recently, the market share of electric and hydrogen vehicles is increasing. However, internal combustion engines will be used for for machines that require large power output, such as large vehicles, construction machinery, and ships. Especially, when we consider the impact of the fine dust and environment pollutants, etc. to the environment and to our human body according to the increase in the supply of automobiles, research and development on the high-performance post-treatment catalyst is required. Diesel engine has advantages compared to the gasoline engine such as high output, fuel efficiency and low CO_2 emission, but due to the combustion characteristics of the diesel engine, nitrogen oxide (NOx) is produced on the local high temperature reaction sections, and there are other issues such as emitting particle matters (PM) during the diffused comb ustion period (Seo, 2012). Main after-treatment catalysts for NOx reduction include LNT (Lean NOx Trap) (Ko *et al.,* 2014; Frola *et al*., 2017; Cant *et al*., 2003), Urea-SCR (Selective Catalytic Reduction) (Xu *et al*., 2007; Seo *et al*., 2011a; Seo *et al*., 2012; Grossal *et al*., 2008; Sjövall and Olsson, 2009; Ciardelli *et al*., 2007) and LNT+SCR (Seo *et al*., 2011b; Castoldi *et al*., 2011; Nova *et al*., 2004) combined systems. LNT Catalyst was already commercialized on the small-sized diesel vehicle, but issues such as fuel penalty and decrease in NOx reduction performance were reported. Urea-SCR Catalyst was commercialized for mid-large size vehicles due to the outstanding fuel efficiency and de-NOx performance, and recently, this catalyst was commercialized also for the 2L-grade small-sized vehicles. Catalysts used on the Urea-SCR Catalyst can be classified into Fe- and Cu-SCR catalysts based on the zeolite support, and zeolite-series SCR catalyst has outstanding de-NOx performance, but there is an issue of the carbon deposition on the catalyst (coking) from the decomposition of HC to have studies conducted on the this issue. Vanadia-SCR catalyst used on other vehicles and vessels has outstanding de-NOx performance and have durability on coking, but it still has the issue of vulnerability on the thermal endurance on high temperature (Seo and Choi, 2015).

This study is to investigate the characteristics of exhaust emissions according to thermal aging, coking and space velocity for commercial catalysts (Cu- and Fe-SCR) currently used for the Euro-6 regulation.

2. EXPERIMENTAL

2.1. Catalyst and Characteristics

Two types of commercial catalysts (Cu- and Fe-SCR) are

**Corresponding author*. e-mail: ckseo@howon.ac.kr