INFLUENCE OF VOC EMISSIONS ON GLOBAL WARMING. MITIGATION OF THEIR IMPACT USING CERAMIC MONOLITHS SUPPORTED Pt, Mn AND Ce CATALYSTS AT PILOT SCALE

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Abstract **- The removal of a mixture of volatile organic compounds ($CHCl_3$, methyl ethyl ketone, toluene and xylenes), was evaluated by adapting a commercial exhaust fan with a catalytic system applicable to small and medium enterprises. The catalysts used were Pt, Mn, Ce, Pt/Mn and Ce/Mn supported on ceramic monoliths. It was observed that all catalysts tested were able to reduce emissions of volatile organic compounds into the atmosphere. The CO_2 equivalent emission of VOCs into the atmosphere (with and without treatment) was determined taking into account the power consumption of the exhaust system + catalyst, being observed for all catalysts tested a reduction in CO_2 equivalent emissions. When a heat exchanger is attached to the exhaust system + catalyst to reduce power consumption, the emission of CO_2 equivalent decreases appreciably in the order of 24.8%–45.3% compared to untreated emissions.**

Keywords **—– Monoliths, Manganese, VOCs, CO_2, Global Warming.**

I. INTRODUCTION

Volatile Organic Compounds (VOCs) comprise a major group of air pollutants, which include alkanes, aromatic hydrocarbons, chlorinated hydrocarbons and oxygenated hydrocarbons. Exposure to VOCs is associated with negative effects on respiration and allergies. Also the role of VOCs as a major source of tropospheric ozone, a known respiratory irritant, has recently been acknowledged (Adgate *et al.*, 2004; Who, 2009).

VOCs contribute to the most serious air pollution problems; first, they have proved active in the formation of smog and ground level ozone production. Second, there are several VOCs that can be classified as carcinogenic. Benzene has been classified as a known human carcinogen by the International Agency for Research on Cancer (IARC) based on evidence from epidemiologic studies and animal data (IARC, 1987; IARC, 2012), and styrene and tetrachlorethylene are classified as possible or probable carcinogens for human beings (IARC, 1995; IARC, 2002).

From the point of view of climate change, VOCs contribute in two ways (Murrells and Derwent, 2007), a major contribution derived from a direct effect if the VOC is a halogenated hydrocarbon, due to its atmospheric life-time and its properties of absorption of infrared radia-tion in the value of "GWP" (Global Warming Poten-tials) or indirectly if the VOC is a hydrocarbon due to its atmospheric chemistry. A secondary contribution from CO_2 results from the degradation of each VOC determined by the number of carbon atoms present in the VOC.

The most important VOC treatment techniques are incineration, catalytic oxidation, adsorption, and condensation, among others, depending on the VOC concentration. Different authors have proposed a catalytic oxidation technology to remove volatile organic compounds from indoor air (Ho and Park, 2004; Mo *et al.*, 2009). Metal oxides or supported noble metals can be used in catalytic oxidation of VOCs. Manganese and cerium materials are widely used in VOC oxidation due to their low cost and high activity, which is attributed to the labile lattice oxygen and their capacity of storing oxygen in the crystalline structure (Craciun, 2003; Tang *et al.*, 2008).

The catalytic oxidation of individual VOCs has been widely studied; however, there are few articles about the removal of VOCs from mixtures. In practical applications, such as treatment of contaminated air from solvent evaporation processes (quick drying systems, printing, paint shops, etc.), the gas stream contains mixtures of volatile organic compounds that are generally of variable composition. In general it is observed that the removal of a single VOC differs from the removal of a mixture of compounds, the effect being attributed to the interaction of the various organic species with the catalyst (Li *et al.*, 2009; Diehl *et al.*, 2010).

The aim of this study is to report on the development and optimization of commercial air extractor coupled to a pilot scale catalytic system for use in small and medium enterprises, and the impact of its implementation on the reduction of VOCs emissions into the atmosphere and consequently, the impact on global warming, by estimating the emission of VOCs as CO_2 equivalent, on