

A mobile pilot plant for supercritical water oxidation of PCB-contaminated transformer oil

Edwin Sánchez and Gustavo Bolaños*

School of Chemical Engineering, Universidad del Valle, Cali, Colombia

* gustavo.bolanos@correounivalle.edu.co

Polychlorinated biphenyls (PCB) are toxic and carcinogenic substances that were used mainly as insulating oils for electric transformers. According to the Stockholm convention, all materials contaminated with PCB must be eliminated in an environmentally friendly manner before the year 2028. A preliminary inventory of PCB in Colombia accounts for the existence of approximately 2000 tons of transformer oil contaminated with PCB, and similar amounts are reported in other countries of the region. Until now, incineration overseas has been the only available way for dealing with these wastes in Colombia. However, many issues concerning transportation logistics make the process economically infeasible for some local companies. Other technologies, such as reductive and substitutive dechlorination are being used at pilot scale for treatment of contaminated oils, but their application is limited to a specific concentration interval of PCB in the oil and require additional and expensive process for oil pretreatment.

Supercritical water oxidation (SCWO) has been shown to be a competitive technology for the treatment of these wastes. Previous work by our group has shown that an oil contaminated with 20000 ppm of PCB can be treated at 539 °C, 100% oxygen excess and 241 bar using methanol as a rate enhancer to obtain a PCB destruction efficiency of 99.61 % in reaction times as low as 30 s. In order to increase the local capacity for treatment of PCB wastes and to avoid risks associated with transportation, we designed and built a standard container-size mobile pilot plant. This SCWO pilot plant has a capacity of 70 kg/h and can be operated from 400 to 550 °C at 270 bar, using hydrogen peroxide as oxidant. The continuous flow multi-injection reactor has a volume of 12 L. A counter-current heat exchanger is used to preheat the feed with the products of the reaction and electrical heaters are used to reach the operating temperature. This work shows some details of the design and preliminary results of the operation of the SCWO mobile pilot plant.

Keywords: Supercritical water oxidation, polychlorinated biphenyls, transformer oil, mobile pilot plant.