

COMBINED PROCESSES FOR THE REMOVAL OF VOLATILE ORGANIC COMPOUNDS FROM AIR

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This article presents a hybrid technique for the removal of volatile organic compounds (VOCs) from gases using electron beam (EB) irradiation and catalytic oxidation in the presence of microwaves (MW). Three reactors were built: MW-R, EB-R and EB-MW-R. The first was used for the study of catalytic oxidation in the presence of microwaves; the second was designed for the study of VOC decomposition under EB irradiation and in the third experiments to determine the efficiency of VOC decomposition were made. The MW-R and EB-R were also used for the combined (successive) treatment of gases.

Table 1. The conditions used for the experiments and the main observations.

Reactor type	VOCs	Observations
MW-R	hexane, toluene, HCFCs	As compared to the conventional catalytic oxidation, the microwave reactor which was used allows for the development of the oxidation on the microwave heating catalyst surface and so, the preheating of gases is no longer necessary. Significant efficiency was obtained for the treatment of gases.
EB-R	hexane, toluene, ethyl acetate, isopropanol, ethyl ether	The favorable effect that water has (at saturation pressure in gases) in irradiation process has been shown. It is known that, by irradiation, water produces OH radicals, which are very efficient oxidizing agents. The efficiency of VOC transformation into CO and CO ₂ (total VOC oxidation efficiency) is always smaller than the efficiency of VOC removal from gases which means that some of the VOCs are transformed into solid particles. This is a characteristic of the irradiation process which produces a great number of active radicals. At low temperatures, these radicals do not all oxidize, but they recombine themselves.
EB-R + MW-R (successive)	hexane, toluene, HCFCs	An increase in the total VOC oxidation efficiency was obtained by means of a successive use of the two reactors. The positive influence of a growth in residence time, of a decrease in VOC concentration and of an increase of MW power were emphasized.
EB-MW-R		The synergistic effect of combined irradiation with EB and MW was emphasized (only the process of SO ₂ and NO _x removal from flue gases was studied).