Phenolic Resins Emissions Upon Thermal Degradation

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Consumable materials pollution has been increasing during recent years. The optimization of vehicle engines lead to an important decrease of fine dust related to combustion. On the other hand fine dust coming from brake pads, pneumatics and roads has been growing. Most of the fine dust produced by consumables is released in urban areas, making of them an important topic to be analysed.

An important part of this kind of pollution is generated by the braking system. In fact almost every terrestrial transport method (cars, bikes, trains or planes) has a braking system. The consumable part of the system is composed by a pad of friction material and a metallic rotor. These pads are composed by a series of ceramic and metallic materials joined together by a polymer matrix, generally a phenolic resin.

Braking pads industry uses a very large quantity of resins. For example, every year in Italy, 150 millions of brake pads are produced. A calculation has been done considering an average weight of 150 grams of friction material for brake pad and a percentage of 7% in weight of phenolic resin in each formulation. For a total amount of 1575 ton of resin used approximately. This number increases by an order of magnitude, if the global scale is considered, where there are over a billion of cars. As a consequence, even the small quantities of polluting gas produced by a single pad are likely to represent an environmental issue.

The aim of this work is to determine the most significant gases that are released during the thermal degradation of phenolic resins. Thermo gravimetric analysis (TGA) were carried out using an equipment coupled with mass spectrometer (MS). Two different samples of phenolic resin, commonly used in braking industry, named Phe_1 and Phe_2, have been investigated. Thermal degradation has been studied both in air and in inert atmosphere (Argon).

Upon thermal degradation the emission of organic molecules like benzene, toluene, alcohols and methane has been detected in the temperature range 400-600°C. As far as inorganic molecules are concerned, emission of CO$_2$ has been observed only for the measure carried out in air, whereas the release of NH$_3$ near 500°C occurred both air and in Argon.