SOOT FORMATION MECHANISM DURING INCOMPLETE COMBUSTION ON DIESEL FUEL

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In the diesel cycle engine, the air flow is constant independent of engine speed, which is regulated by fuel flow only. The diesel "smoke" often observed is largely due to overloaded engines or poor maintenance under such conditions at critical fuel-air ratios the fuel is unburnt but "cracked" and the emissions may contain a variety of hydrocarbons[2].

The aim of this work is to understand the formation of soot during incomplete combustion of hydrocarbons. Some polynuclear aromatic hydrocarbons are suspected to have hazardous effects on human health. Soot formation is largely determined by the chemistry that forms and converts small hydrocarbons radicals, that leads to precursor molecules from these species, and that converts the precursors molecules[1,4].

As we see in the pictures given Fig.(1,2) the hydrocarbon fuel in premixed flames is degraded during oxidation into small hydrocarbon radicals from which, under fuel-rich conditions, small hydrocarbons, are formed. For later adds hydrocarbons radicals for growth and the growing unsaturated hydrocarbons form aromatic rings. When containing a large number of carbon atoms.

The growth in the third dimension we believed to happen via coagulation due to large aromatic structures forming soot particles[3]. These particles quickly coagulate picking up simultaneously molecules from the gas phase for surface growth. Surface growth contributes to the major part to the final soot concentration in sooting exhaust while coagulation. The irregular structure of soot particles is also attribute to coagulation. The chemical process mentioned above contribute to the formation of the size of soot. From the literature the formation of electrical charged of soot particles, the formation charged and neutral of fullerenes, or the formation of tarry modifications with optical properties quite different from polynuclear aromatic hydrocarbons or carbon black necessitate more information from this picture.However, the mechanistic picture given for the formation of soot emphasizes the ideas behind the scientific approaches to the problem of the soot formation during incomplete combustion of hydrocarbons.

In conclusion the major pollutants problems from diesel engines are unburned hydrocarbons, unburned carbon (visible exhaust) and NOx. The first minimised by design control and the latter by well maintenance of the engine.

References

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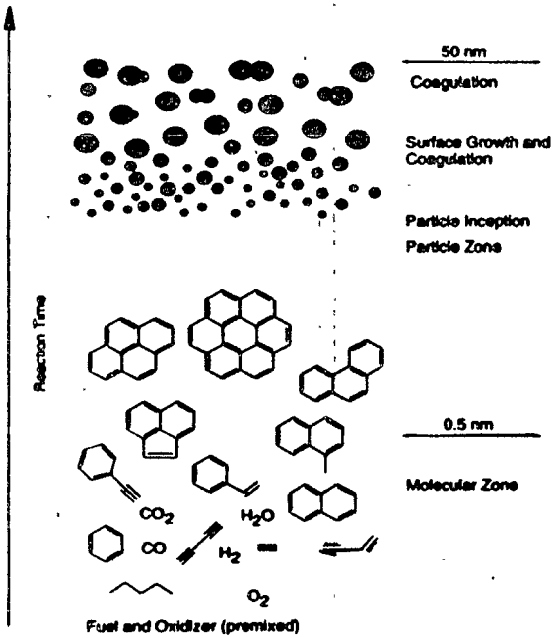

FIG. 1. A rough picture for soot formation in homogeneous mixtures (premixed flames).

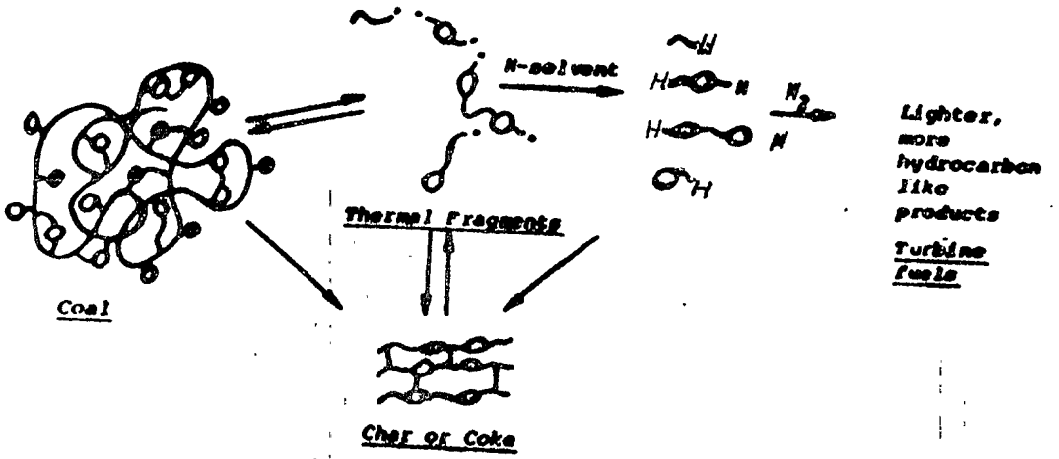

FIG 2. Schematic diagram illustrating formation of hydrogen-rich products and coke from coal (modified Whitehurst et al., 1960).