# *SUMMARY*

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The disposal of used automotive tyres is an increasing economical and environmental problem for most of the developed countries. Tyre is made of rubber materials (polybutadiene, styrene–butadiene rubber and polyisoprene or natural rubber), carbon black and some fibrous materials. It has high volatile and fixed carbon contents with heating value greater than most of the coals. These characteristics make rubber from old tyre a good raw material for thermal or chemical processes.

They belong to the class of non-environmental materials. Environmental materials refer to those which can maintain ecological balance; moreover, they have superior properties and the best environmental compatibility. On the other hand, scrap tyre is bulky and is not a biodegradable residue and, therefore, it is not possible to achieve its degradation in landfills. As a consequence, open dumping of scrap tyre not only occupies a large space, presents an eyesore, cause potential health and environmental hazards but also illustrates wastage of valuable energy resource. Waste tyre pyrolysis has been widely studied for years. This thermal process seems to be an alternative to direct combustion processes because no hazardous emissions are produced and the recovery of solid and liquid material is achieved. Furthermore, used lubricating oil also represent another type of waste material of valuable importance.

Different variables that could affect the pyrolysis process have been studied. After tyre pyrolysis, three phases are obtained: solid, liquid and gas.Their composition is related to the factors applied on the reaction. The solid phase, is mostly constituted of carbon black but also contains minute traces of  mineral matter initially present in the used tyre. The gas phase contains a mixture of light hydrocarbons and carbon dioxide. The pyrolysis gases can be used to provide the energy requirements of the pyrolysis process. Finally, the liquid phase is a hydrocarbon mixture in which significant concentrations of some valuable components like olefins and aromatics. The present work aims to invetigate the effect of different variables on the components and the precentages of the products. From this point of view, the following parameters were thoroughly studied:

1-*Effect of temperature*.The reaction was carried out at temperature range (200-400 $^0$C).

2-*Effect of oil/tyre ratio*: The reaction proceeded at oil:tyre ratio ranging from1:1-3:1. The oil ratio didn't exceed this ratio to obtain wide range of products.

3-*Effect of catalyst*: all the previous studies that concerned the tyre pyrolysis reaction used complex catalysts. The present work involved the application of three simple, cheap and available catalysts for the pyrolysis reaction of mixture of oil and tyre.

4-*Effect of catalyst concentration*: the reaction was performed at narrow range of catalyst connentration(0.25, 0.5 and 1% of the total weight of reactants). It is of interest to mention that the ratio of catalyst is controlled within this range to control the variability of the products obtained from the reaction.

Furthermore, the selected catalysts were mixed together in order to investigate the effect of both catalysts on each other and on the composition of the reaction products. The data reveal that the products of reaction can be varied markedly with the change in the reaction condition.

Concerning the temperature, it was found that the increase in the reaction temperature shifted the product composition towards the paraffins. This may be explained by the effect of temperature on supplying the reaction with enough activation energy to start the reaction and to continue the bond breaking reaction. This was true whatever the reaction condition is.

As a catalysed reaction, it was found that the % paraffin increased with the increase in the concentration of catalyst. This was excpected for all the investigated reactions and normally explained by the effect of catalyst on enhancing the degradation reaction. In some batches the % paraffins showed remarked increase such as % Paraffins for $3AO_{200}$ at different concentration of catalyst which increased from 67.6% to 91.6%.

Regarding the oil/tyre ratio, it was found that the high oil ratio shifted the reaction towards the production of paraffins as expected since the oil is the source of paraffins whereas the rubber is the source of olefins. It was observed that some reactions had an optimum value for the % paraffins( increased then decreased again), which may be explained by cracking reaction that may occur at higher oil ratio.

The present work involved application of three catalysts in the pyrolysis reaction [Aluminum oxide (AO), Aluminum chloride (AC) and Calcium chloride (CC)]. It was found that AO is the most effective catalyst in shifting the reaction products towards the paraffins. Upon using mixed catalyst system, it was found that AO/AC is slightly more effective in producing paraffins than AO/CC. This was attributed to the synergestic effect of each catalyst on the other.

The % olefins of some selected samples were confirmed by detecting the olefinic bonds via IR spectroscopic technique and the results obtained were coinciding together. Furthermore, the char characherization was also concerned. It was noticed that the % of the obtained solid yield (14-20%) is close to the reported by other authors. This leads to the conclusion that simple catalysts could play the role of complex catalysts in catalyzing the pyrolysis reaction of scrap tyres and used lube oil in order to eliminate the hazardous effects of these materials on the environment.