Characterization of Post-Pyrolysis Tyre Char as a pigment in Aqueos Ink-Jet Printing Inks: Using Different Analytical and Spectroscopy Technique

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Abstract: Disposal of used tyres is becoming an increasingly important environmental issue and the recycling is a more environmentally friendly solution than mass accumulation.

A process known as pyrolysis enables the recovery of potential useful products from the rubber portion of used tyre ,such as pyrolytic oil, gas and a carbon black pigment (CB_p).Therefore the study was aimed to assess whether the recovered carbon could be used as a pigment in aqueous based inkjet printing inks.

The (CB_p) contained a higher concentration of inorganic compounds than commercial carbon black,mainly due to the various additives incorporated in the manufacture of the original tyre.The contamination is reflected by the high content of the ash present in the (CB_p).

A characterization of the recovered carbon black was performed and a possible reduction of the ash content by an acid-base demineralization treatment and physical separation techniques were investigated,thereby improving its quality.

In this study we evaluate the properties and performance of the recoverd carbon char as a pigment in water-based ink-jet links.The success of this project could help resolve a major environmental issue and thus be a benefit to us all.

The post-pyrolysis car tyre CBp (obtained from coalite ,Debyshire, UK) which was stored under room temperature and pressure and ground to a mean partical size of 20µmThe samples were characterized and evaluated by using different analytical and spectroscopy technique, such as X-ray Flourscence Spectroscopy.

Keywords: *Pyrolysis, carbon black, pigment, tyre.*

INTRODUCTION

Increasing numbers of used tyres have become a problem. The most common way of dealing with them is recycling, which entails great economic losses and environmental pollution (Dhir, *et al* 2001). Recent data show that in the European Union, 2.5 million tons of used tyres appear each year, equivalent to 80% of new tyres are made up of different materials: organic ones of a polymeric type, such as natural or synthetic rubber, inorganic ones, and metals. This complex structure makes recycling difficult (Williams, *et al* 1995). A possible solution to treat used tyres not as waste, but as an energy resource (Williams, *et al* 1998).

Carbon Black is a particular form of industrial carbon produced by thermal cracking or decomposition of a hydrocarbon raw material. More than 90% of carbon black is produced using the oil furnace process,which involves injucting an aromatic petroleum distillate into preheated closed furnace and then cooling and collecting the carbon aggregates that have been formed.by controlled mainuplating of reactor conditions it is possible to vary particle size,aggregate size,and surface chemistry to creat a board range of carbon black properties to be used in awide range of applications (Pakdel, *et al* 1992) The recovery of carbon black product is different in structure ,morphology and chemical composition in comparison with virgin carbon blacks Typically carbon black properties that best describe the high performance level of both automotive tyres and pigment based inkjet inks (Williams, *et al* 2002).

The post-pyrolysis car tyre (CBp) (obtained from coalite, Debyshire, UK) is carrying out recovery of used car tyres, based on the separation of the polymeric and metal contents .in this case

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of used car tyres, the company has set up a pilot pyrolysis plant where used tyres are subjected to thermal decomposition into two fractions, solid and gas, both of which can be used as fuel for generating energy.

EXPERIMENTAL

Samples of the Post pyrolysis char were collected in special containers, the determination of ash content used to quantify the amount of non-organic mineral matter present in a sample, Ball mill with assorted milling balls, Laboratory furnace, crucible,measuring cylinder, Semi-quantitive XRF, Ash content, Chemicals and reagents.

Qemscan is the most powerful process mineralogical tool currently employed in the mineral industry for quantitative evaluation of minerals and inorganic substances.

The samples was analysed using the partical mineral analysis mode.this was where the electron beam is rastered over individual particles at a pre-determined beam stepping interval (pixel spacing) and a mineralogical map of each particle was obtained.

RESULTES AND DISCUSSION

Ash content in (Fig. 1) show that CBp has a substantially higher ash content than the two commercial carbon black grades (CB01 and CB02) that are currently available for inkjet applications.

The results in (Fig. 2) show that CBp has a substantially lower carbon content than the two commercial carbon black grades (CB01 and CB02) that are currently available for inkjet applications.

The proximate analysis of CBp,and two commercial grades of carbon black designed specially for inkjet printing.

Semi-quantitave XRF: The results in the Table 1 show that the major contaminats found in CBp are the elements Si,S,Fe,Ca and Zn.The carbon content was calculated by difference, giving around 85%.

The results in Fig. 3 below show the main contaminant elements: silica,Sulfur and Zinc, whilist carbon content is calculated around 85%. The main major compounds identified in the used tyre cahar from pyrolysis process as tentatively

Table 1. Results of semi-quantitave XRF analysis performed on the CBp.

Element	Concentration %	Element	Concentration %
Na	0.209	Ca	1.05
Mg	0.123	Ti	0.0291
Al	0.205	Fe	1.08
Si	3.51	Co	0.0295
S	3.98	Cu	0.0696
Cl	0.0990	Zn	3.56
K	0.104	Br	0.0679

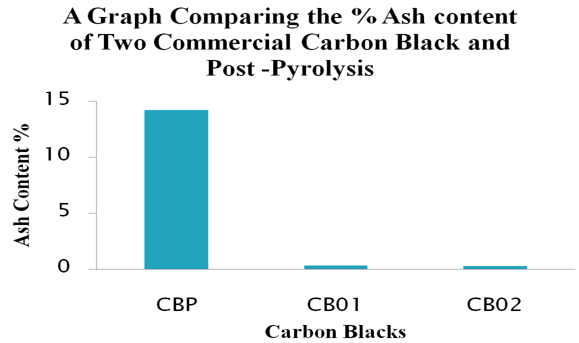

Fig. 1. Ash content (%).

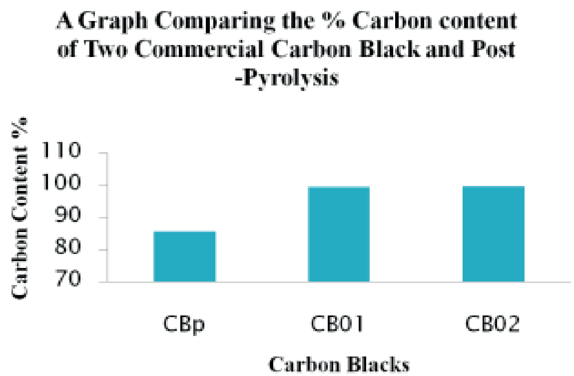

Fig. 2. Comparison of two commercial carbon and post pyrolysis.

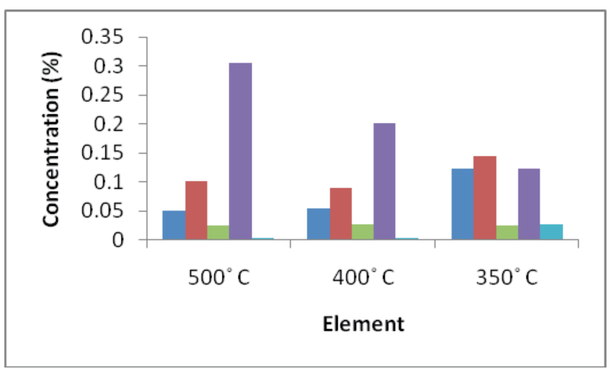

Fig. 3. Elements at different temperatures.

identified by GC-MS chromatograms are shown in Figs. 4, 5, and 6.

Generally, it has been suggested that the pyrolysis of used tyres may be successful new recycling method when tyres are no longer suitable for their orginal applications.that are usually dumped in landfill sites, burnt in cement kilns ,or turned to tyre crumb. It has been suggested that pyrolysis of used car tyres may be successful new recycling method. When tyres are no longer suitable for their original application.

The results from this study show that the CBp recovered from tyre pyrolysis has a carbon content around 85%,which is much lower than that of most commercial grades of carbon black used in the printing

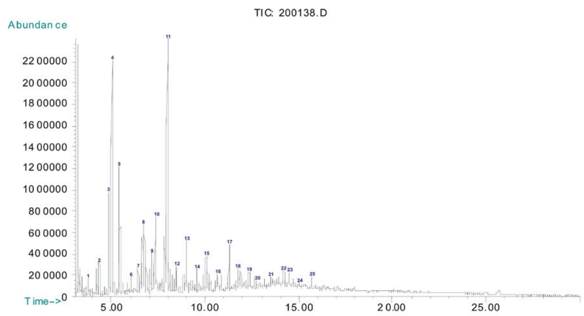

Fig. 4. GC-MS Chromatogram for carbon black char at 500ºC.

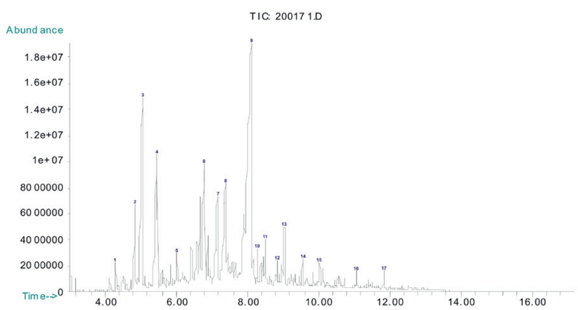

Fig. 5. GC-MS Chromatogram for commercial carbon black 01 at 400ºC.

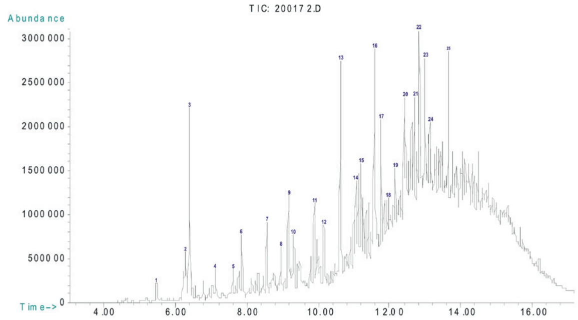

Fig. 6. GC-MS Chromatogram for commercial carbon black 02at 350ºC.

industry. The ash content of the CBp was determined to be higher than that of the commercial grades.

CONCLUSIONS

The pyrolysis of used car tyres has been thoroughly researched during the preceding 20 years on a small laboratory scale. Initial results from tyre pyrolysis were deemed sufficiently promising to lead to scale up. This current project had access to samples from a pilot plant obtained at different temperatures.

Pyrolysis may be an interesting option of waste tyres recycling. There are many technological variants of the process. As a result of waste tyres pyrolysis one may obtain valuable chemical semi-products or fuels. The full utilization of the waste tyres pyrolysis products is possible after their further processing.

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