NOVEL USES FOR TIRE PYROLYSIS CHAR

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Introduction

Char produced from the thermal conversion of used automobile tires contains a blend of the carbon blacks used in the manufacture of the tire as well as "ash" constituents formed in the pyrolitic process. This mixture provided a challenge to determine possible secondary and tertiary uses. Early work attempted to separate the "ash" fraction from the carbon black species.(1). Subsequent effort uncovered the relationship between the carbon black and the ash fractions and suggested a reverse method of formulation. Because all of the materials found in the char were derived from the recipes used in building the tread, side-wall and bead of the tire, it was anticipated that these materials, in ratio, could be used for other blended engineering materials. The idea of using the char as a "basic" starting material for formulated chemical specialties outside of the rubber industry was supported by two factors:

1. The potential volume of the char material was calculated at sixty tons per day.(2)
2. The composition the char did not vary by more than 0.5% in ratio of items.

These two considerations prompted further study and application evaluations.

Materials and Methods

One ton of shredded used automobile tires were processed using the Svedala Pyrolysis System (3), The shreds were reduced to a gas, "oil" and char. The char fraction is one third of the feed weight ,six hundred sixty seven pounds yield per ton of tires. Of the six hundred and sixty seven pounds of char, eighty five percent is carbon black and fifteen percent is ash. The char was ground to a uniform mesh size (4) to allow blending and dispersion to occur more easily in subseqnent formulations. The char was used in the following applications in order to determine the value added.

Results

Simultaneous Mercury, Sulfur Dioxide and Nitrous Oxide control in coal combustion by adsorption. The tire derived char was compared to silver impregnated activated carbon at laboratory level to ascertain the sorbent performance. Early tests showed that the char derived from pyrolysis of used automobile tires was equal to the silver impregnated activated carbou, indeed Mercury sorption on tire-derived activated carbon was identified as the most promising application.(5).

Carrier media for distillation of wastes derived from ink, paint, coatings and dry cleaning processes. The char derived from the pyrolysis of used automobile tires was evaluated as a "carrier" for mixed wastes generated by the paint, ink and coatings industries. The wastes evaluated contained aliphatic, aromatic solvents dispersed with pigment, filler, plasticizer and resins. Addition of 7.0 to 11.0% of the char created a mixture that allowed complete evolution of the solvents and absorbed the remaining ingredients of the waste creating a dry solid matrix. The dry solid was then re-ground to a uniform size and evaluated as an extending material for adhesives, synthetic lumber.(6)

Char may be used as an extender in adhesives, coatings and cements. Additions of 3.0 to 7.0% of char to blends of vinyl or rubber cements resulted in lower raw material cost with no loss of physical or chemical properties. The modified cements were tested in floor adhesives, tile adhesives and panel-stick compounds. Neither tack nor drying characteristics are affected by the addition. A stiffening of the finished adhesive bond was determined but did not affect the permanence of the bond.(7)

Discussion

Each application outlined above has been evaluated by no less than three investigators. Work done by others, including Advanced Fuel Research, Rohm & Haas, Morton International Automotive Finishes Group and others confirm that the inclusion of tire derived char, when properly ground and classified, can be nsed as a pre-engineered extender and physical property modifier. Extensive aging tests are being conducted on products utilizing the char. Among the properties within new rubber products that are affected include hardness, elongation, tensile and compression set.(8)

Conclusions.

The investigation of pyrolysis systems appears meaningful in light of the various uses found for the char produced through thermal conversion of used automobile tires. The economic model (9) represents an average value of the char at no less than $0.18 per pound. This "value" coupled with the value of the collected oil product and the energy value provides the support for re-evaluating pyrolysis as one technology to diminish the stockpiles of used tires.

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References

(1) Dr. Mark A. Petrich, Northwestern University, Chemical Engineering Department, Evanston Illinois.
(2) United Carbon Corporation, planned facility at California City California, Business Plan and conversation with Marshall J. Field, President.
(3) Michael H. Weinecke, Senior Development Engineer, Svedala Industries, Test Center, Oak Creek Wisconsin; Results of On-Going Production of char product.
(4) Ibid. Svedala Grinder Division Equipment
(5) Marek Wojtowicz, Advanced Fuel Research, SBIR Phase I study, East Hartford Connecticut
(6) David Miklos, Environmental Manager, Morton Automotive Group, Rohm & Haas Corporation, Lansing Illinois, Results of testing and production results.
(7) Gary Post, Applied Recycling Technologies Inc. St. Petersburg Florida. Current use of char in composite lumber production.
(8) Steve Mobley, ProTurn Corporation, Oregon City Oregon, Urethane Foam Rubber mechanical parts used in construction equipment.
(9) Economic model available upon request to author.

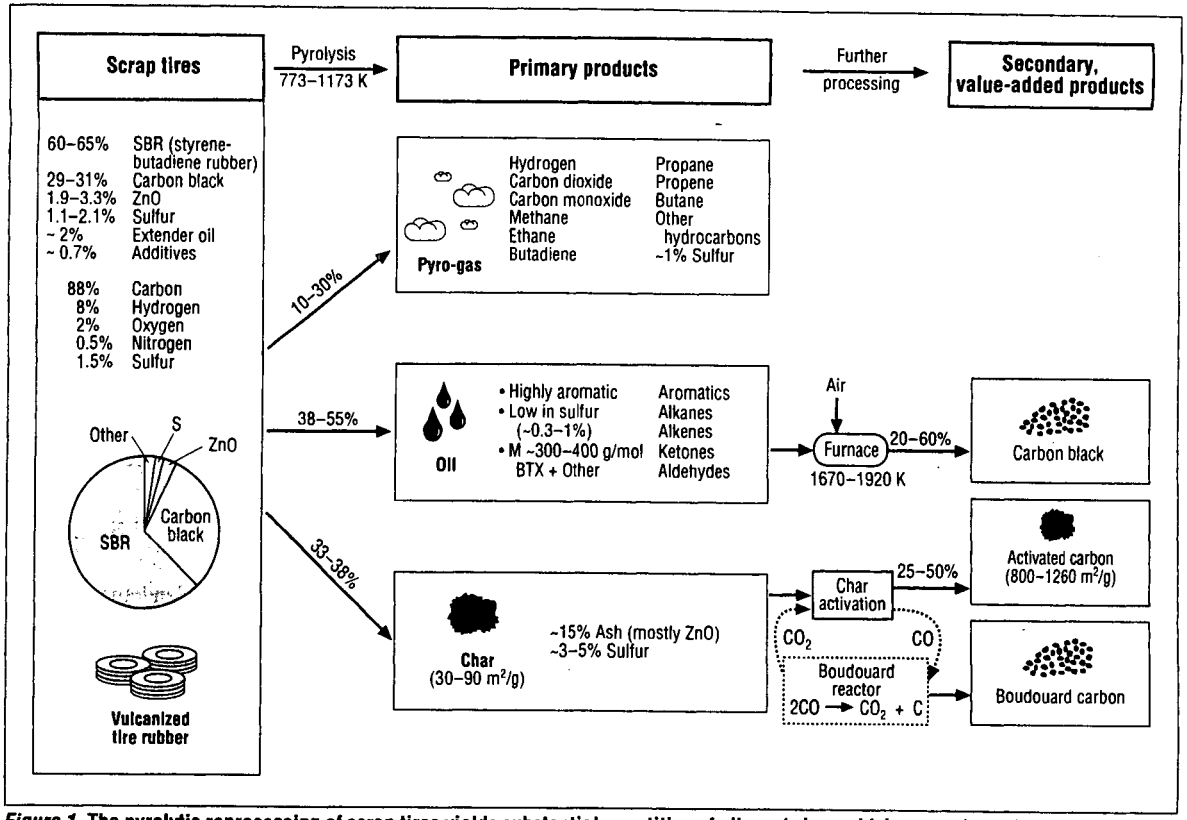

Figure 1. **The pyrolytic reprocessing of scrap tires yields substantial quantities of oils and char, which can undergo further processing to secondary, value-added products.** Char upgrading results in producing high-surface-area activated carbon and Boudouard carbon. Ash-free oils are turned into high-quality carbon black, or the oils can be separated into valuable chemical feedstocks by distillation.