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## Best Practices in Scrap Tires & Rubber Recycling

### ***Fillers for Rubber Compounds - Non Black***

#### ***Material: Recycled Rubber from Tires, Industrial Scrap Rubber, and Post-Consumer Scrap Rubber Products***

**Issue:** *Almost all virgin rubber compounds (99%) utilize either carbon black or inorganic fillers such as precipitated or fumed silica, clay, ground or precipitated calcium carbonate, titanium dioxide, zinc oxide and several others as reinforcing agents and/or extenders for rubber compounds. Recycled rubber contains the same fillers as the virgin rubber from which the recycle was produced.*

**Best Practice:** There are significant quantities of mineral fillers used in rubber compounds. These include both natural and synthetic fillers. The major synthetic filler used is precipitated silica. This silica is 0.02 micron in average particle size. The silica is added to enhance the modulus and tear strength of tire compounds. It is also used as an ingredient in fabric and wire bonding systems. The silica, along with resorcinol and hexamethylene melamine, are used extensively in wire adhesion systems. Typically 10-12 phr of silica is used. In addition, several tire compounds designed for very low rolling resistance have 60 phr of silica coupled with a silane coupling agent to achieve very low tangent delta values in the tread. The silica has an average surface area of 150-175 square meters per gram. About 200 million pounds of silica are used per year in the U.S. and growing rapidly.

Clay is also used as a semi-reinforcing agent for rubber, and about 900 million pounds is used per year in the U.S. Most is hard clay mined in Georgia and South Carolina. It is used in tire carcasses, sidewalls, and bead insulation. Clay offers some reinforcement to the rubber compound but less than reinforcing grades of carbon black. The cost of clay is typically \$0.03 to \$0.05 per pound. Silane modified white clays are used in white sidewalls.

Ground and precipitated calcium carbonate is used in rubber compounds. The ground products are added as extender fillers, while the precipitated types offer some reinforcement due to their small particle size. It is reported that over one billion pounds of calcium carbonate is used in rubber compounds in the U.S. per year. In addition to the other fillers mentioned, zinc oxide is added for cure activation, titanium dioxide is added to white sidewalls for whiteness, alumina trihydrate is used as a flame suppressant, talc is added as a filler and extrusion aid, and several other mineral fillers are used for special purposes such as conductivity and color.

**Implementation:** All of the above fillers are mixed into rubber compounds. In general more mineral fillers are used in non-tire compounds than in tire compounds. Non-black fillers are used in mats, wire and cable, footwear, rolls, hoses, belts, weather-stripping, and many other types of products. The mineral fillers added are usually after the polymer in the internal mixer or on the mill. Levels commonly used are 5-100 parts. The amount of non-black filler may vary and is usually lowered when also integrating crumb into a recipe due to the reinforcing effects of the crumb from its inherent fillers. Some EPDM compounds may have levels of several hundred phr for low cost materials.

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**Benefits:** All mineral fillers are usually white or light colored so the one obvious benefit is that non-black mineral fillers can be used to make light colored goods. Silica is used at 10-15 phr in wire skim compound for steel belted tires. It increases Modulus and improves wire adhesion. In addition it is used in many radial and passenger tire components to stiffen the compound. Silica is also used by Michelin and Goodyear in the treads of the fuel efficient, low rolling resistance treads. It is used in conjunction with a polysulfidic silane coupling agent. Clay is used in a few tire components. These include some carcasses and white sidewalls. It is used at 40-65 phr. Clay is extensively added to mechanical goods to lower cost and provide some reinforcement. Calcium carbonate is added to lower cost, improve processing, and impart light color. It generally provides very little reinforcement or strength enhancement to the rubber.

**Application Sites:** Non-black fillers are used at almost every location making rubber parts, including tires.

**Contact:** For more information about this Best Practice, contact the CWC at (206) 443-7746, email [info@cbc.org](mailto:info@cbc.org).

### References:

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4. Degussa, Ridgefield Park, NJ, (210) 641-6100.
5. Flexsys, Akron, OH, (330) 668-8377.
6. ECC International, (404) 303-4411.
7. Huber, J.M., Macon, GA, (912) 454-4751.
8. Polymer Valley Chemicals, Akron, OH, (330) 945-6499.
9. Kaolin, Thiel, (912) 553-951.
10. Burgess, (912) 552-2544.
11. Engelhardt, (908) 205-5000.
12. RT Vanderbilt, (203) 853-1400.
13. ECC International, (404) 303-4411.
14. Genstar, Hunt Valley, MD, (410) 527-4225.
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