TECHNOLOGY

Billion Pounds of Soot

Nearly a billion pounds of carbon black added to rubber each year to produce better tires. Seventy million pounds used in printing newspapers, magazines and books.

By MARTHA G. MORROW

➤ CARBON BLACK, the fluffy, velvety soot produced when natural gas or oil is incompletely burned, is serving man in hundreds of ways:

Nearly one billion pounds of carbon black are added to rubber each year to make your tires wear better.

Seventy million pounds of carbon black are used in printing newspapers, magazines and books.

Twenty million pounds reinforce and color paints.

Carbon black is useful because it reinforces not just rubber, but also cement, lacquer and asphalt. Its great ability to absorb light provides blackness in paints, papers and inks. Its power to adsorb chemicals makes it useful in collecting gases and stray electrons in radio tubes. Its affinity for oxygen is used in reducing metallic alloys.

You probably have seen carbon black in dozens of products without realizing it. Most black candies and cough drops are colored with it. Black carbon paper and typewriter ribbons are effective because of carbon black. Black shoes, rubbers, raincoats, telephones, shoe polish and crayons are black because of it; phonograph records and combs often contain it.

A little carbon black improves the insulating properties of rubber and other substances because of its enormous adsorptive surface. But used in large quantities, carbon black is a good conductor of electricity and helps rubber, resins and paper transmit electricity. Carbon black itself is used in dry cells, radio resistors and arc carbons because of its great electrical conductivity.

Fluffy carbon black is used as a sponge to make roofing asphalts and lubricants flow less easily. It is employed in making metal carbides, such as tungsten carbide, useful as abrasives because of their hardness. Carbon black combines with liquid oxygen to make a powerful explosive.

Soot From Candle and Spoon

You probably remember that soot soon collects on a metal spoon, knife blade or letter opener held in the flame of a candle. If you hold the spoon high above the flame, there is little smoke and little black deposited on it. But when you put the spoon in the flame, thick black smoke rises from the burning candle and soot soon coats the cool metal.

This demonstrates that the wax in a candle burns pretty completely when there is plenty of air. But when a spoon or other object cuts down the air supply, the carbon from the wax is not burned so completely and may be collected on a cool surface.

If you hold a spoon close over the burning wick of a candle and then look at the color of the soot deposited on it, you will find that not all soot is jet black. In addition to the pure black deposit, some will be gray. Thus in producing carbon black, care must be taken to be sure it always is jet black.

Over one and a half billion pounds of carbon black were produced in the United States last year. This is enough to fill 25,000 freight cars holding 60,000 pounds each. Single plants produce as much as 200,000 pounds a day.

The modern furnace plant is an impressive lay-out with massive steel towers, tanks and superstructure. In the distance it might well be mistaken for an oil-refinery or chemical plant.

Carbon black particles are infinitesimally small, far smaller than those of any other commercial product. Because they are so fine and thus even a small quantity has a large surface area, carbon black has excellent hiding power. The surface area of one pound of carbon black would cover 15 acres. This makes it valuable in inks and paints.

Carbon black has been used as a pigment in printer's ink since the invention of printing. And thousands of years before that the Chinese and Egyptians used it to make permanent symbols. In fact, the oldest Egyptian hieroglyphics on papyrus that we know of were written with carbon ink.

Permanence and surface area are largely responsible for the use of carbon black in printer's ink. Two pounds of carbon black make enough ink to print 67,000 full-size newspaper pages. Each printed letter in a newspaper contains about 8,800 million individual carbon particles, and the dot at the end of this line contains about a billion carbon particles.

Rubber Reinforcement Use

By far the largest use of carbon black is as a reinforcing pigment in rubber. This year well over a billion pounds of carbon black will be mixed with rubber to make it tougher so it will wear better.

Of today's rubber goods, one pound in every five of natural rubber is carbon black, one pound in every three of synthetic rubber is carbon black. Not only is much rub-

SOOT CATCHER—Last traces of carbon black are removed from the flue gas in these three bag filters where the soot-carrying gas is passed through the finest Orlon fabric. Note that no soot escapes from the stacks.

ber saved by the use of carbon black, but the carbon black compounded into tires actually extends the life of a tire at least five times.

When formed, millions of carbon particles cling together in fluffy clusters like bunches of grapes. To break down the clusters, various mills or mixers are used in paint, ink, rubber, paper and other industries.

Carbon Black Size Varies

There is a wide variety of carbon blacks to meet varying demands. Just as carbon black varies in color, so it varies in size. Carbon black particles range in diameter from 10 millimicrons to 300 millimicrons, where a millimicron is a thousandth of a micron or 1/2,500,000,000 of an inch. A blond hair is 50 to 100 microns across, and thus gigantic in comparison. The size of the particles varies with the material used and method of manufacture.

Burn a fresh Brazil nut or a piece of rubber band, and black smoke rises from it. This is soot just as much as the fluffy black material that collects over an oil burner or inside a chimney. It all results from the incomplete burning of oily hydrocarbons such as gas or oil. Intense heat or incomplete combustion cracks up the hydrocarbon molecules and strips off their hydrogen.

Carbon black can be made from anything that releases carbon. Insufficient air, which causes a gas or oil burner to smoke, is the clue to its manufacture. Cost of the raw material pretty much determines the material from which carbon black will be made.

Different Production Methods

Turpentine, for instance, would be an excellent source of carbon black were its cost low enough. Most carbon black is produced from natural gas or oil. Thus carbon black factories are located in the Southwest, right in the natural gas and oil fields.

Carbon black is produced in a number of ways. In making soot with a candle, it was the cold metal surface of the spoon which collected the carbon black. An elaborate form of this is the impingement process. It employs many small flames which strike metal channels or rollers that collect the carbon particles from the flame. These small flames produce the finer carbons.

The furnace process, in contrast, employs relatively huge flames confined in furnaces. The thermal process, which uses gas, employs heated furnaces in which the hydrocarbon gases are decomposed into carbon and hydrogen. In the lampblack process, which produces coarse carbon black, oil is burned in open pans and collected in settling chambers.

Up to a few years ago, practically all the carbon gases are decomposed into carbon the United States. Even today, more is manufactured in the United States than in all other countries combined. Research is now under way to develop finer carbons tailored to meet specific needs. Also there is a concerted effort to increase manufacturing efficiency so more carbon black will be produced for the gas and oil used.

Specimens of carbon black, products using it and a candle for making a little have been collected for you by Science Service. A total of eight specimens, and suggested experiments to perform with them, are included in a kit which you can secure for 75 cents per kit or three for $1.50. Write Science Service, 1719 N St., N.W., Washington 6, D. C., and ask for the Carbon Black kit.

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MEDICINE

Rapid Thawing Best As Frostbite Treatment

➤ BEST TREATMENT for frostbitten feet, legs or hands is rapid thawing in a warm bath at a temperature of 95 to 113 degrees Fahrenheit, Drs. Martin A. Entin and Hamilton Baxter of McGill University, Montreal, reported to the American College of Surgeons meeting in New York.

"To be most effective, the thawing must be immediate, rapid and penetrating," they declared. Warm water or diathermy are recommended for the warming. The temperature should not go above 113 degrees Fahrenheit.

Rapid thawing is painful, they pointed out, so sedatives should be given.

Delayed thawing is really mild warming of already thawed tissue and may be harmful, they pointed out. Exposing a frostbitten limb to temperatures higher than 122 degrees Fahrenheit is harmful, their studies showed. Neither ACTH nor another drug, hexamethonium, were found of enough use to be considered practical for treatment of frostbite cases.

In some of the experiments, rats were precooled before their legs were frozen, to simulate the condition of acute frostbite in a foot of an injured soldier following prolonged exposure to the elements on a battlefield. The rats in such experiments lost more tissue than the controls, showing that frostbite is worse in a person who has already been chilled all over before frostbite set in.

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