

Synthetic Rubber Produced from Turpentine.—A new type of high-quality synthetic rubber, made with a chemical derived from turpentine, has been developed by scientists of the Bureau of Agricultural and Industrial Chemistry. This achievement, a result of work begun during the war by the Bureau's Naval Stores Research Division, makes it possible to use turpentine as a supplementary source of synthetic rubber in a national emergency. Under present conditions rubber from turpentine is somewhat more costly than GR-S, the most common synthetic rubber now produced commercially. But the new synthetic, compounded for use in tires, is slightly stronger than GR-S rubber, stretches better, and generates less heat under stress.

Main ingredient of the new elastomer is isoprene, a compound that forms the basic molecular unit of natural rubber. It is obtained from turpentine by a special molecule-splitting process developed by Bureau researchers. Isoprene produced from petroleum is already used in some types of synthetic rubber now on the market. The Bureau's method of producing it from turpentine should be a valuable national asset in the event of emergency shortages of petroleum.

First step in synthesizing rubber from turpentine is to produce isoprene from the turpentine's hydrocarbon constituents, called terpenes. Each molecule of isoprene has 5 atoms of carbon and 8 atoms of hydrogen. Terpene molecules are made of exactly twice this number of atoms—10 of carbon and 16 of hydrogen. Scientists of the Naval Stores Research Division devised a process for splitting the terpene molecule in half to obtain two molecules of isoprene.

This is done by immersing a conductor of high-resistance iron wire, heated red hot by an electric current, in boiling turpentine. The liquid vaporizes around this conductor and is heated to about 1400° F. When terpene molecules in the vapor strike the wire at this temperature they are split in two. The split molecules—*isoprene*—immediately bounce off into the liquid turpentine, which cools them sufficiently (even though it is boiling) to prevent further decomposition.

A continuous, two-stage distillation process removes the newly formed isoprene molecules from the turpentine bath and keeps them from again touching the red-hot wire. A water-cooled condenser first liquefies some of the vapors from the bath to unchanged turpentine, which is returned for further treatment. The remaining vapors, containing the *isoprene*, pass to a second condenser where they are liquefied with solid carbon dioxide ("dry ice"). This procedure gives a 70 per cent yield of isoprene that is about 95 per cent pure. It is made 99 per cent pure by redistillation.

In producing synthetic rubber, the purified isoprene (either alone or in combination with styrene, a compound used also in GR-S rubber) is mixed with water, soap, a catalyst, and a modifier, and shaken for a specified time at a warm temperature. One formula, found to yield approximately 80 per cent of high-quality synthetic rubber suitable for use in tires, calls for 75 parts (by weight) of isoprene, 25 parts styrene, 180 parts water, 5 parts soap, 3/10 part potassium persulfate (as a catalyst for the copolymerization of the isoprene and styrene), and 2/10 part mercaptan (which regulates the polymerizing action). This mixture is shaken for 14 hr. at a temperature of about 120° F. The resulting synthetic rubber has a tensile strength of about 3800 psi., will stretch to seven times its length, and in standard tests develops 7 to 18° F. less heat under stress than similarly produced and compounded GR-S rubber.