CHEMISTRY

New Rubber Plant

Government-owned factory for making synthetic product suitable for tires and tank treads is twin plant, operated by Carbide and Carbon and U. S. Rubber.

See Front Cover

➤ SYNTHETIC RUBBER of the Buna S variety, good for tires all the way from jeep to super-bomber sizes, as well as for tank treads and other Army uses, will flow at the rate of 90,000 long tons a year out of a huge new plant set-up in Charleston, W. Va., which has just gone into full-scale production.

Government-owned, the new installation consists of two separate but closely integrated plants, each under the management of a well-experienced industrial organization. The first plant, where the raw materials are produced, is managed by the Carbide and Carbon Chemicals Corporation; the second, where they are converted into the final product, by the United States Rubber Company. The two plants stand side by side, so that a casual observer would think they were one; short pipe lines carry the raw materials from one to the other.

Scarcely over a year ago, there was nothing on the broad, flat plain by the Kanawha river but farm and pasture land adjoining a small airport, near the suburban station called Institute, from the presence there of a state teachers' college. Now the place is an industrial giant, capable eventually of making rubber to rim 16,000,000 civilian car wheels every year.

Buna S is the synthetic rubber made by mixing two organic compounds, butadiene and styrene. Butadiene in turn can be made from either petroleum or alcohol; at this plant alcohol is used. The alcohol is brought up the river by barge or in railroad tank cars; it comes from the great Ohio valley distilleries that have stopped making liquor to devote their entire capacities to war-alcohol production. A "tank farm" with a total storage capacity of 750,000 gallons insures a constant working supply.

Styrene, the other ingredient, is made at the Charleston plant by combining benzene and ethylene. Benzene is produced in abundance near by; it is a coke-oven by-product, and there are many coke-ovens in the valley. Ethylene is one of the lighter petroleum fractions.

Both butadiene and styrene must be brought to a high degree of purity before they can successfully combine to produce Buna S. At this place, the Carbide and Carbon Chemicals plant brings the butadiene to 98.5% purity and the styrene to 99% before putting them into the pipe lines to go over to the United States Rubber plant.

Both chemicals are limpid, water-clear liquids as they flow into the great mixing vessels. As soon as they are well in contact, however, they combine to form a milky fluid—a true latex, filled with billions upon billions of submicroscopic rubber particles.

These are held from combining with each other because all have electrical charges of like sign. The latex is flowed into another great vat, where a salt-water solution containing a little sulfuric acid is mixed in. The salt removes the electrical charges, and the rubber particles stick together in grains or crumbs.

These are put through a mechanical shredder and washed thoroughly, to remove all chemicals that may still cling to them. Finally the raw rubber particles are showered down into the oblong mold of a powerful press, that squeezes them into 75-pound loaves. These are packed in cartons for shipment to the tire factories.

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RUBBER—At a new buna S synthetic rubber plant in West Virginia, this rubber is being produced for use in tires and tank treads. When the Government-owned plant is in full production, enough rubber to make 63,000 tires will be produced daily. At the left is shown the rubber after removal of the electrical charges causes the particles to stick together. At the right rubber has been dried and pressed into loaves.

CHEMISTRY

Resin Aids Production of Rubber from Castilla Tree

➤ RUBBER from the castilla tree, abundant in the American tropics, may be made more easy to prepare through the use of a resin extracted from another warm-land American plant, related to the common morning-glory, known as moonvine or Nacta. Researches pointing to this possibility are reported by three Department of Agriculture scientists, S. G. Wildman, A. V. McMullan and Rosamond Griggs, who worked in the laboratories of the Bureau of Plant Industry (*Science*, May 21).

Castilla latex, although a good source of high-quality rubber, has been difficult to handle commercially because it would not respond to the chemicals used in coagulating the latex of the Hevea tree. Reports from the tropics that natives used moonvine juice to get rubber from Castilla inspired the search for a chemically controllable process based on the same plant.

Fortunately, the moonvine grows in

plenty in southern Florida as well as in the tropics, so that the three researchers could get all the fresh material they needed. A long and patient series of chemical extractions finally produced a clear, yellow, resin-like substance. This was tried on Castilla latex gathered in Mexico, and brought out the rubber quite satisfactorily, at least for small-scale laboratory conditions.

The three researchers treat their preliminary results with proper scientific caution. They say:

"These data are suggestive of the use that this resin may find in the commercial production of Castilla rubber. Since, however, absolutely fresh latex has been unavailable, we are hesitant in predicting the coagulative powers of Nacta resin under field conditions, and for this reason, we are withholding comment and interpretation of the data contained in the tables until the results of further trials on fresh latices have been ascertained."

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PUBLIC HEALTH

Workers' Health Guarded

Accomplishments of science in the synthetic rubber industry set a new record for protection of workers, Hygiene Association is told.

➤ AMERICAN science has achieved a new high in protection of industrial workers' health by its accomplishments in the synthetic rubber industry, F. S. Mallette of the Firestone Tire and Rubber Company, Akron, Ohio, declared at the meeting of the American Industrial Hygiene Association in Rochester, N. Y.

In striking contrast to what has happened all too often in the past when new industrial processes were developed, industrial hygienists did not wait until after the synthetic rubber industry was fully going and workers had become sick before investigating the hazards and finding ways to correct them.

"In the great biological research laboratories of the National Institute of Health, the Mellon Institute and the Dow Chemical Company, study of the physiological effects of butadiene, styrene and acrylonitrile, used in the synthesis of Buna S and N types rubber, was begun before Pearl Harbor," Mr. Mallette stated. "By the time the government plants, managed by top-ranking rubber companies, were ready to produce for America's war needs, methods had been perfected for the control of vapors incident to the synthetic process."

In his report, Mr. Mallette did not minimize the potential dangers to synthetic rubber makers, but he did describe clearly the methods and tests for protecting them fully.

Each of the three basic ingredients of synthetic rubber may cause trouble. Acrylonitrile is a cyanide, "a toxic compound comparable to a molecular equivalent of hydrocyanic acid." Each of the ingredients has a characteristic odor that might warn of its presence, but, Mr. Mallette cautioned, this cannot be relied on because the sense of smell gets tired and may fail to signal danger in time.

Fortunately, the almost complete enclosure of the Buna S manufacturing process prevents exposure of the workers to all but low concentrations of the vapors, Mr. Mallette said. Butadiene is harmless apparently in all concentrations below the lower explosive limit. Low concentrations of both it and styrene can be detected by a benzol indicator. For higher concentrations, the explosimeter or combustible gas indicator are effective. Mr. Mallette advised a combustible gas alarm for permanent protection of areas such as pump houses, storage depots and the like, where vapors might accumulate.

Scientists do not believe, from their extensive animal studies, that workmen are in any danger of sickness from cumulative action of butadiene after inhaling small amounts repeatedly.

Styrene might irritate eyes, skin and breathing apparatus, but the scientists who have studied it have set a tentative permissible limit of 400 parts per million as being safe.

For acrylonitrile the permissible limit has been set at 20 parts per million. No practical method or instrument for detecting this substance in the air of workrooms is yet available, but tests of the workers' blood and urine for thiocyanate provide a useful means of checking the degree of exposure. This biological test has been used as a guide in planning ventilation control for the protection of workers in Firestone's "Butaprene" plant. Periodic examinations have shown that these synthetic rubber ingredients have no blood damaging effect, such as that produced by benzol.

The points of potential exposure to the chemicals in the synthetic rubber manufacturing processes are in the handling of raw materials, coagulation, centrifugation and drying, Mr. Mallette stated. He concluded with the following warning:

"Adequate local and general exhaust ventilation must be provided for coagulating tanks and centrifuges. The escape of vapors from the dryers can best be prevented by maintaining a slight negative pressure within them. It may be necessary to provide hoods over the dryer outlets to control vapors of styrene and other substances driven off at this point."

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PHYSIOLOGY

Destroyer of Blood Cells Ever Present in Body

➤ A DESTRUCTIVE enzyme which destroys the vital red blood cells during certain diseases may be ever present in our bodies. Ordinarily an inhibitor in the tissues and blood serum holds the enzyme in check.

Evidence that this mechanism exists is reported in the British journal, *Nature* (Feb. 27), by Brian Maegraith, G. M. Findlay and N. H. Martin of the West African Force.

Certain tissues, such as the lung, liver and kidney, will destroy washed red blood cells suspended in salt solution, the scientists observed. But this action is checked by adding blood serum. Addition of a minute bit of the poisonous chemical, sodium cyanide, or heat application also inhibited blood cell destruction.

Men, monkeys and guinea pigs have been used in the experiments. So far it appears that the cell destroyer in an animal acts only on its own species, while the inhibitor will also protect the blood cells of other animals.

Discovery of this action, if substantiated, will aid those trying to combat lytic anemias, such as the mysterious blackwater fever to which the armed forces are exposed in tropical areas.

Science News Letter, June 5, 1943