CHEMISTRY

Nylon Has Many New Uses

Tough, versatile plastic has been found to have wool-like qualities adaptable to rugs, socks and sweaters. Felt, velvet and upholstery fabrics can also be made of nylon.

By MARTHA G. MORROW

➤ NYLON, famous as the glamour thread that makes stockings more sheer than silk, is proving itself a tough plastic adapted to many new uses. Don't be surprised if you find:

Golf club heads with a nylon protective coating.

Gears and bearings of nylon in adding machines and electric shavers.

Wrist watches with straps made of it.

Nylon heads on soft impact hammers used in metal work.

Harps and guitars strung with nylon.

The fiber is proving its versatility by acquiring wool-like qualities. Thick, serviceable rugs are made of nylon, as are warm, quick-drying men's socks and soft, woolly sweaters. Felt, velvet and upholstery fabrics can be made entirely of nylon, or of nylon in combination with other fibers.

Nylon in Short Lengths

These new textiles are possible because nylon is being produced in short lengths. The continuous filament is given a permanent wave, then cut into lengths of a few inches so it can be handled like wool or cotton.

The name nylon is a generic term used to designate not one compound but a whole family of related compounds. These nylons are similar in chemical structure, but may be made in different degrees of toughness, hardness, flexibility and color. The formula used to produce dull nylon yarn, for example, is different from that used in making nylon for plastic cups and faucet washers.

A nylon molecule contains atoms of hydrogen, nitrogen, oxygen and carbon. One important type of nylon is made by the union of two chemical compounds with the involved names of hexamethylene diamine and adipic acid.

The diamine is made from coal (coke), air and water; from cyclohexane, a petroleum product; or from furfural, which comes from such farm by-products as corncobs and oat hulls. Adipic acid is made either from coke, air and water, or from petroleum.

The Du Pont company neither makes stockings nor forms plastic articles. They manufacture nylon yarn for stockings and the material from which plastic fabricators make such things as nylon combs and gaskets. Each pair of stockings, for instance, contains only about 10 cents worth of nylon.

Nylon salt, the starting point for either hosiery or plastics, is dissolved in water to make it easier to ship. Upon reaching the spinning plant, the solution is heated to evaporate the water. When a certain concentration is reached, it is heated in an autoclave, a kind of giant pressure cooker. Here heat links the relatively small nylon salt molecules into giant ones.

This process, carefully controlled as to temperature and duration, gives nylon a molecular structure somewhat similar to wool and silk.

The hot, syrupy nylon is next allowed to flow out onto the broad rim of a large, slowly revolving wheel. Here a shower of water cools and hardens the nylon. The white ribbon is dried and chopped into flakes.

If the nylon is to become yarn, the translucent flakes from various batches are blended and melted. The liquid nylon is pumped out through tiny holes in a spinneret, a metal disc about the size of a silver dollar and as thick. To insure a filament of even diameter, the molten nylon is made to flow uniformly. Through each of these holes comes thousands of feet of thread each minute.

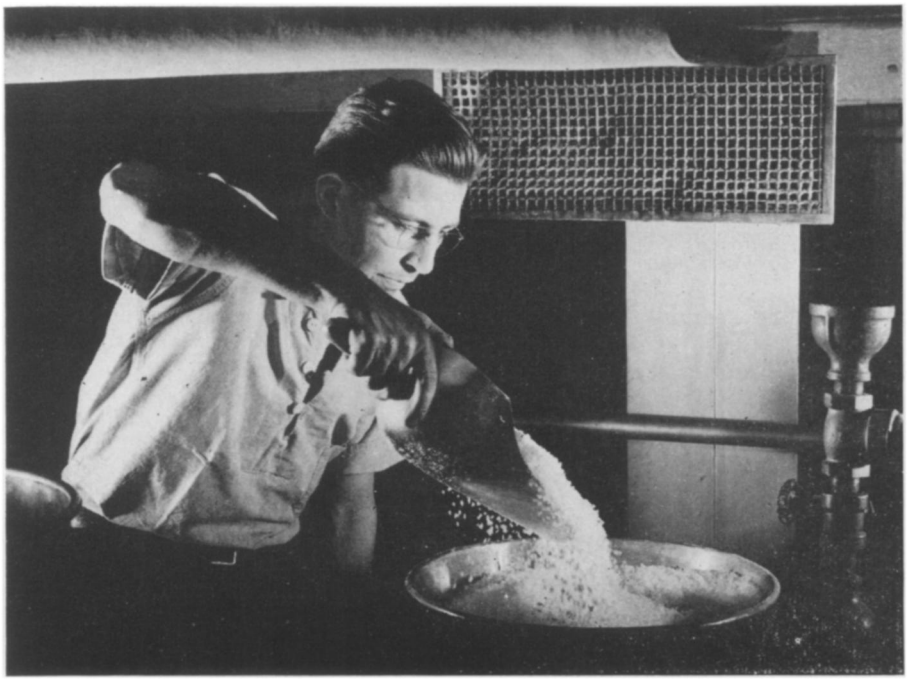
Formula Varied Slightly

If the material is destined to be molded like a plastic, the ivory flakes are thoroughly dried and ground up into nylon molding powder compounds. The formula may be varied slightly, depending upon the finished article.

Nylon is a thermoplastic, so can be reheated and reshaped a number of times. It does not soften until the temperature goes much higher than that at which other thermoplastics soften—well above 300 degrees Fahrenheit.

The finished article, on the other hand, can hold its shape at relatively

HANKS OF NYLON—These will be used for bristles in tooth, hair and industrial brushes. They are inspected as they are tied up in preparation to being cut into bristle lengths.



NYLON FLAKES—This shows them being fed into the hopper of a spinning machine where the flakes are melted and extruded into filaments.

high temperatures. Drinking glasses and nursing bottle funnels of nylon can be sterilized by steam without harm.

Melted nylon flows about as readily as light lubricating oil. Being so fluid, the plastic can be molded satisfactorily into articles of complicated shape and delicate structure. Nylon insulated wire played an important part during the war in keeping communications open on battle fields.

Sheets of the plastic, useful in machining a small number of pieces, can be made either by squirting out liquid nylon in sheet form or by slicing pieces of the required thickness from a nylon block. Strips of this sheet, like the yarn, can be stretched to several times their original length. Rods of various diameters permit samples for new applications to be machined and tested prior to the purchase of expensive molding equipment.

Bristles for brushes are made from thick strands of nylon. For hairbrushes and toothbrushes, the nylon bristle is of uniform diameter. A large number of long strands, tied together, are cut simultaneously into short lengths. Bundles of these are later fed into automatic machines that give tooth and hair brushes their bristles.

Bristles for paint brushes are more difficult to make. They must be tapered so the brush will flex properly and spread the paint well. Molten strands of nylon, coming from a spinneret with fairly large holes, are pulled away at a carefully controlled varying rate. By pulling now faster, now slower, the diameter of the strand is alternately decreased and increased.

Nylon textiles being made today in continuous forms include both the single or monofilament strand and a number of strands twisted together, called multifilament.

Multifilament Yarns

Multifilament yarns are made in both standard and high strength. They range in size from 20 to 210 denier (450 meters of one-denier yarn by definition weighs five centigrams). Single filament yarns are made in 15 denier and, for super-sheer stockings, have been produced experimentally as fine as 10 denier.

Only within the last year has nylon become available in cut-to-length, staple form. After being drawn to several times their original length to orient the molecular structure and increase the strength and elasticity, the strands are crimped by moist heat and pressure, and cut into short pieces, called staple. Thus nylon can be used in combination with other short fibers. When used alone, in the form of staple, it produces a thick, wool-like fabric.

Filament deniers of nylon staple range from 1½ to 15. A 15-denier yarn is about three times as fine as a human hair

Do You Know?

Cotton probably leads all the cultivated crops in attracting a great variety of insect enemies; more than 100 species attack the cotton crop in one way or another.

One type of *seismograph,* an instrument used to detect and record earthquake vibrations, magnifies ground motion 100,000 times; weak quakes thousands of miles away are picked up by it.

Following the two great *earthquakes* in 1906, in California and Colombia, a world-wide interest resulted which is responsible for the establishment of many new seismograph stations to receive and record earth motions.

There are four basic *odors* classified by scientists as fragrance, acid, burnt and caprylic; caprylic comes from a Latin word meaning goat and applies to all animal odors with the best known example perhaps that of a wet dog.

and contains approximately 300,000 yards of yarn to the pound.

Stockings and socks regain their original shape when washed because they have been permanently "set" with steam or very hot water. Once given a desired shape or form, they hold this shape permanently.

Nylon was first introduced to the public about 10 years ago. Twenty years ago the late Dr. W. E. Carothers, its discoverer, little dreamed that his research would lead to a material versatile enough to be used both as a plastic and as a synthetic textile fiber.

Nylon made its first public appearance as a toothbrush bristle. It established its popularity as yarn for sheer, quick-drying stockings. During the war it was so much in demand for military use that for more than three years no nylon was available commercially, except possibly in toothbrush bristles.

Today nylon is used in tire cord and laundry nets, garden hose and work gloves, sailcloths and trolley cords. It is beginning to appear in self-locking nuts and hypodermic needles, in phonograph needles and lawn sprinklers. Still an experimental product, nylon's usefulness is just beginning to be explored.

Science News Letter, June 12, 1948

ENTOMOLOGY

Test DDT in Wind Tunnel

➤ MOSQUITOES in a wind tunnel are the newest means for testing the effectiveness of DDT in aerosols or fogs, such as are used for the large-scale "depesting" of summer resorts, athletic stadiums and the like.

The work is being done as a joint research project at the Beltsville, Md., experiment station of the U. S. Department of Agriculture, near Washington. First results are reported in the *Journal of the Washington Academy of Sciences* (Nov. 15, 1947).

The wind tunnel is small, as compared with those used in aviation research: only a foot square in cross section and 32 feet long. About midway of its length a wire cage containing the victim mosquitoes can be inserted. Air speeds are low, simulating normal out-of-door conditions: they ranged from two to 16 miles an hour in the present experiments.

DDT fog was released by a standard method, to give particles of controlled diameters, from one to twenty microns —that is, from droplets about the size of the smallest known bacteria up to specks just barely visible to the naked eye. Mosquitoes in batches were bombarded with particles of all sizes, at the four velocities used. Results were measured in terms of percentages of dead mosquitoes.

In general, it was found that better kills were obtained with the larger DDT-fog particles, and that higher air velocities were more effective than lower ones. It was even possible to plot the results as ballistic curves. The experiments are still being carried on.

Earliest results, just reported, were obtained in a joint research program shared by the U. S. Bureau of Entomology and Plant Quarantine and the Central Aerosol Laboratory of Columbia University, supported by OSRD and NDRC funds. Workers were Drs. Randall Latta, Lauren D. Anderson, E. E. Rogers, V. K. LaMer, S. Hochberg, H. Lauterbach and I. Johnson.

Science News Letter, June 12, 1948