Materials for Orthopedic Appliances

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The purpose of orthopedic appliances and artificial limbs is to enable those people unfortunate enough to be crippled or disabled in some manner to live and pursue life as normally and as comfortably as possible. In order to accomplish this seemingly impossible feat, a disabled person must seek out the aid of a team of professionals, namely, the doctor, the orthotist and/or prosthetist and the therapist. This team then works for the ultimate in comfort and usefulness for the patient.

A small but very important aspect of obtaining the ultimate in comfort and usefulness for the patient is in the hands of the orthotist-prosthetist, not only in constructing a properly fitted appliance or limb, but in the selection of the best applicable materials for each particular appliance.

In recent years, tremendous strides have been made in improving materials with which to construct appliances, for instance, advances in alloying techniques in metal manufacture make possible the production of cast irons which are a far cry from the low-strength brittle castings of twenty-five years ago.

Plastics have come into their own, in the manufacture of artificial appliances. Plastics can now be molded, cast machined, laminated and formed in many other ways. Plastics are available in more than a dozen general types, each type having been developed to meet definite needs and possessing both specific advantages and specific limitations.

The only material that has not been changed to any great extent is leather. The reason for this is the fact that, although there have been many types of substitute materials used, not one has been valuable for orthopedic use.

There have been changes in the manufacture of leather, not to improve the final product, but to modernize the production. From the time the raw hides are unloaded until they are shipped out again in the form of finished leather, they are handled and processed by mechanized equipment which sets new standards of efficiency for the age-old craft of leather making.

Production begins with inspection and trimming. Inspection is a vitally important operation at this point, for the hides are bought and paid for before they are seen and it is up to the raw hide inspectors to determine whether the quality is up to the specifications.

In the trimming room, the heads, bellies and tails are trimmed off. These trimmings drop onto a conveyor and are taken up into a storage bin located above the level of the shipping platform. When the bin is full, the trimmings are sold as glue stock. In the trimming room the hides are cut in two, slit down the backbone to form sides, for easier handling during the balance of processing. A number, stamped on each half as the hide is split, identifies the packing house from which the hide comes. An electric hoist raises the sides to a platform running along the top level of a line of washing drums, so that they can be dumped into the drums without lifting. This preliminary wash operation removes salt and foreign matter, and replaces moisture lost by evaporation during transportation and storage. At the end of the wash cycle, the drums are emptied from

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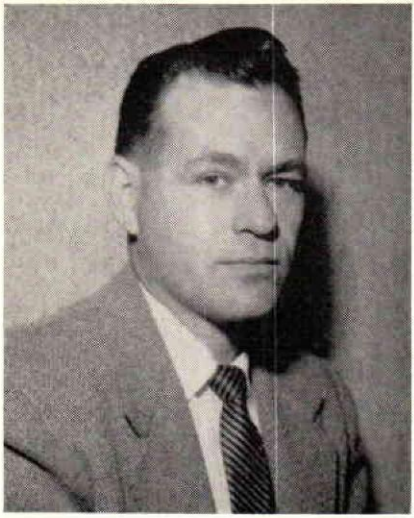

Julius Biro, a veteran of World War II, was employed in the limb shop of the Naval Hospital in Philadelphia, after serving in the Aleutians with the "Seabees." Until he joined the staff of the Anthony Medical Supply Co., in 1957, he was in charge of the Orthopedic Department Leather Shop at the Institute for the Crippled and Disabled, and before that was in charge of the Amsterdam Brace Shop in the Hospital for Joint Diseases.

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the bottom position, the contents being dropped to trucks which take them to the finishing machines. Here spiral-bladed knives remove the surplus flesh. This waste material is pumped to a storage bin and is subsequently sold for commercial gelatins and glue.

The hair is loosened by soaking the hides in lime vats, a period of from three to five days usually being required to loosen the hair sufficiently to insure its ready removal on the unhairing machine. The hair from the unhairing machines is a valuable by-product. It is pumped to a machine, where it is washed, dried, fluffed up and baled. It is sold for use in making of rug pads, typewriter cushions, insulation materials, and other products. Another inspection follows unhairing, after which the hides are trucked to the tanning drums. The pretanning operations of bating and pickling are done in these drums as well as the actual tanning. Pickling, which follows the bating operation, involves a treatment with sulphuric acid and salt. This serves to bring the hide into proper condition for tanning.

The chrome tanning liquors are cooked in kettles that open at the floor of the tank house, and the completed liquors are stored in quantity on the floor below. After the pickling operation in the tanning drums is completed, a measured amount of chrome liquor is fed by gravity into the drums and the hides are "drummed" until tanning is completed. After tanning, the leather is dropped from the drums and piled flat on platforms to drain. Then it is trucked to the wringers where the excess liquid is squeezed out and passed through "setting-out" machines which remove the wrinkles and lay out the flanks of the hide so that the leather is smooth and flat throughout.

The next operation is known as the "bluesort," the name being derived from the fact that the leather at this point has a distinct bluish-green color from the chrome tan. The blue sort is a rather amazing sorting process, for the highly skilled sorters may make as many as thirty-two different divisions of the leather as they sort it for grade, weight, defects, and for right and left sides. Splitting comes next, the sides being sliced into two layers to give a grain layer of the proper thickness. The flesh splits are finished into work gloves, luggage linings, and specialty items of great variety.

After splitting, the leather is weighed up into lots of the proper size and thrown into the coloring wheels for bleaching or dyeing. Following coloring and another setting-out operation to smooth the leather, the sides are ready for drying. Drying is done on a continuous basis with the leather pasted to glass plates. The paste solution is sprayed on the large glass plates and the leather is brought into close contact by squeegeeing it out flat with metal slickers. The paste operators work from the center of the hide out to the edges, removing the wrinkles and some of the stretch as they work, so that the leather will dry flat and smooth.

Operations remaining after the drying include staking, buffing and brushing.

Finishing may involve the application of as many as seven coats of finishes. These finishes are generally applied by a machine, although hand work is required in certain phases of the operation to insure the best possible results. Various types of finishing materials are used, depending on the end results desired, but in general such properties as flexibility, good adhesion, water resistances, crock resistance (that is, resistance to rub-off), and good filling action are considered essential. The finished leather may be passed through a graining machine which brings out the natural grain appearance and it is then plated. This is done on hotbed presses and serves to bond the finish to the leather and improve the luster of the surface.

After plating, all rough edges of the leather are trimmed off. Then the sides are passed through a measuring machine which shows the size of each piece in square feet. Next the colors are checked again against a master color sample to make sure the shade is exactly right, and sorters make a final check for grade, weight and quality. The leather is then ready to be bundled and shipped. Hides are composed of thousands of fibers, and, when the hide is made into leather, these fibers enable it to transmit air and to dissipate heat and moisture. Leather also possesses strength, firmness and flexibility.

Plastics characteristics in general are ease and cheapness of fabrication and attractive appearance. In comparison with metals plastics are weaker and less stiff in sheets of equal thickness, lighter in weight, and good electrical and thermal insulators.

Metals are very resistant to organic solvents but are attacked to a greater or lesser degree by acids and bases. Certain plastics are resistant to many solvents, but, in general, plastics are attacked by organic liquids although they are relatively inert toward aqueous acids and bases and resistant to corrosion. Metals are crystalline and ductile, plastics usually amorphous (except for nylon, polyvinylidene choloride, polyethylene and fluoropolymers) and formed with heat rather than by cold drawing or casting from a melt. Although not so stiff as most metals at the same

thickness, plastic articles can frequently be made stiffer than corresponding metal articles of the same weight because of the much lower densities of typical plastic materials. Some plastics provoke little or no tissue reaction.

In comparison with leather, solid plastic sheets are not permeable to moisture and the softer grades are not as resistant to tearing; but they have wider color possibilities, are available in transparent and translucent grades, more resistant to abrasion, weathering and bacterial action, do not absorb perspiration, and are much easier to keep clean.

In comparison with wood, plastics are somewhat more dense, more transparent in many cases, non-absorbent, superior as electrical insulators, and some grades are flame resistant. In addition to these factors, the use of plastics is usually favored because of their handsome appearance, uniform color and physical properties and ease with which they may be cast, molded, or extruded.

The foregoing describes in general the large variety of materials available to the technician in the field, and indicates that the choice of material for the job at hand is tempered by the properties desired. Since a wide range of attributes is necessary, familiarity with the general characteristics of the available materials is of paramount importance.