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COATED ABRASIVE

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This invention relates to the manufacture of coated abrasives, particularly coated abrasives that may be used either in the dry state or wet but has more particular reference to coated abrasive papers that are to be used wet, usually after soaking in water to increase the flexibility of the product. This latter class of coated abrasives is generally known to the trade as waterproof sandpaper.

One object of the invention is to provide abrasive paper particularly adapted for use where water or water containing some wetting or lubricating agent is used on the work during the abrading operation. Another object of the invention is to provide a flexible product for the use indicated. Another object of the invention is to provide a backing which will cooperate with a coating for rendering the coating resistant to peeling or other separations from the backing. Another object of the invention is to provide a flexible product suitable for use where oils and similar lubricants are used on the work during the abrading operation. Another object of the invention is to provide a cheap and simple process for the manufacture of a product with one or more of the advantages indicated. Another object of the invention is to provide a product with one or more of the foregoing advantages combined with a superior wet strength.

The invention accordingly consists in the features of construction, combinations of elements, arrangements of parts, and in the several steps and relation and order of each of said steps to one or more of the others thereof, all as will be illustratively described herein, and the scope of the application of which will be indicated in the following claims.

I have found that the correct preparation of the base paper stock is important and as an illustration of my process, detailed instructions will be given for the manufacture of 40 lb. paper. The paper stock used may be rope, jute, chemical wood pulp, purified wood pulp, cotton or various combinations of these and other suitable fibres. By way of illustration a suitable furnish may consist of 60% rope fibre suitably cooked as is known in the art and 40% of a good grade of kraft pulp. The furnish is introduced into a beating engine and the paper stock is beaten to the required degree. By variations in the beating practice, the penetration of the oil, varnish or other material described hereinafter may be controlled. In some cases it is desirable that there be considerable penetration of the paper base by the oils or similar treating bodies hereinafter described, while in other cases less penetration is desired, and the oil applied serves primarily to seal the surface pores.

The time of beating required will depend to a considerable extent upon the pulp used and its previous preparation and treatment. In many cases pulp which has been beaten to about a Schopper-Riegler test of 30 degrees and jordaned to 60 degrees will be satisfactory. After the paper pulp has been sufficiently beaten, it is run through a Jordan to a Fourdrinier paper machine and the sheet is formed in the usual way, dried in the usual way and taken down in the form of rolls slit to any convenient width. The paper so prepared may be treated with suitable oils as hereinafter described.

Instead of using paper as described and especially where a high wet strength is required in the final product, the paper may be treated as described in co-pending application Serial No. 89,268 filed July 6, 1936. In this case the paper stock is beaten to a Schopper-Riegler test of about 30 degrees and the paper is formed, dried and taken down as described. It may then be treated on tub sizing equipment or similar paper treating equipment with a 1% solution of viscose as cellulose which has been pre-treated with sufficient boric acid to practically neutralize the alkalinity of the viscose solution. Ammonium carbonate may then be added in sufficient quantities such that the liberation of carbon dioxide on the dryers may tend to complete the regeneration of the cellulose, such completion of regeneration being subject to control through the amount of ammonium carbonate added.

In lieu of the foregoing treatment, viscose may be added in the beater but I have found that better results are usually obtained by adding the viscose to the paper after the web is formed. In some cases it is an advantage to add the viscose to the beater in that the fibre furnish may then be beaten to any required degree to produce the desired resistance to penetration by the treating oils subsequently applied.

As another alternative, instead of adding the viscose as a separate operation after the paper has been removed from the paper machine, the viscose solution may be added after the paper has had only part of the water removed or during its passage through the drying cans, by the customary arrangement for tub sizing on a paper making machine.

I may also in some cases treat the paper made, either with or without the wet strength treatment, with a water solution of Sorbitol or of tri-

ethanolamine oleate to soften or plasticize the backing before the coating operation hereinafter described is carried out.

In lieu of viscose as just described, the paper web may be treated with a solution of glue and glycerine to which has been added paraformaldehyde to tan the glue. The glycerine serves as a plasticizer for the very brittle glue and also serves to soften the cellulosic fibres. Instead of paraformaldehyde I may also use formaldehyde or hexamethylene tetramine or chrome alum to tan the glue.

In lieu of viscose or the glue-glycerine treatment previously described, I may treat the paper web with a solution of hide glue, such as for instance a 10% solution of 62 millipoise hide glue and 20% sorbitol in water. In this case the solution should be applied to the paper web at a temperature of about 125° to 150° F. The paper is then dried and may be treated with a water solution containing 10 to 15% formaldehyde to tan the glue. The paper is again dried and calendered. The sorbitol is less subject to changes in effectiveness with changes in the moisture content of the atmosphere and is further less volatile and more permanent than glycerine. For this reason sorbitol is a preferred material for softening glue and for softening the cellulosic sheet and fibres therein.

By an agent adapted to impart wet strength to a sheet, I mean an agent which does not materially prevent the absorption of water by the sheet and which enables the sheet to retain materially more wet strength after being soaked in and permeated by water than would be the case if the agent were not used. As illustrations of such agents, I have cited viscose and tanned glue. Where viscose is used, the viscose is either decomposed deliberately or decomposes with time to produce what is known as regenerated cellulose. By the term "regenerated cellulose" I mean the decomposition product of viscose or equivalent materials and a typical process of regeneration has been described in the specification.

By an agent adapted to soften the sheet I mean an agent which is capable of rendering the paper sheet materially softer and more flexible when dry than would be the case if the agent adapted to soften the sheet were omitted. So far as I am aware, agents which are suitable for this purpose are also water soluble and in this way differ materially from the water-resistant oil treatments previously used in preparing paper for use as coated abrasive backings. Typical agents adapted to soften the sheet have been cited in this specification and include glycerine, sorbitol and triethanolamine oleate. These materials not only soften cellulose but also soften animal glue and where glue is used as a wet strength treatment, these softening agents serve to soften both the paper and the glue, all as previously stated.

It will be apparent to those skilled in the art that many variations may be made in the process of forming the paper. Likewise many variations may be made in the softening process and in the process of producing high wet strength.

I have discovered that certain oils which cure to a flexible jelly state have peculiar advantages for my purpose. While certain non-drying oils such as castor oil find some application in this invention, I prefer to use the semi-drying oils such as dejelled linseed oil or blown soya bean oil. By dejelled linseed oil I mean an oil that has been produced by partially cracking a jelled linseed oil to destroy the firm linseed oil jelly and produce instead thereof, a viscous definitely fluid product. Such dejelled linseed oil, soya bean oil and similar semi-drying oils, when dried or set, tend to produce a very flexible and firm jelly but under ordinary conditions of drying or curling do not set up to give a final product which is as hard or tough as China wood oil similarly cured, China wood oil being definitely in the class of drying oils, and subject to severe oxidation and other reactions which eventually result in a comparatively hard brittle film. Paper treated with a controlled quantity of the semi-drying oils is well adapted to cooperate with a variety of coating materials as hereinafter explained. The product formed is definitely more flexible than a product similarly made with drying oils and varnishes. While paper treated in accordance with this invention is generally less flexible than that described in copending Application Serial No. 89,268 filed July 6, 1936 and formed by saturating paper with a water emulsion of semi-drying oils, for many purposes the product made in accordance with the present invention is satisfactory and cheaper. Generally speaking, the process of the present invention is more economical, especially in regard to the quantity of treating oils used.

While the emulsion and alternate processes described in the aforesaid application are usually carried out with porous papers known as saturating papers, the present process may be and more often is carried out with less porous papers, and may be used to advantage with papers that are relatively resistant to oil penetration, as for example, as presize and backsize coating treatments.

As an illustration, the treatment of 40 lb. paper will be described in detail. Lighter or heavier papers may, however, be used according to the product desired. The porosity of the paper may vary within limits determined by the product intended, as for instance, the extent of penetration of oil required.

From considerations of both economy and quality of the product, I often find it advisable to add to the paper, oil treatment to the extent of about 20 to about 50% of the base paper weight. A preferred oil is heavy blown soya bean oil. A suitable viscosity for the heavy blown soya bean oil used by way of illustration is from about 18 poises to about 40 poises at 140 F. For the quantity of oil that will be incorporated in this illustration, the base paper stock before treatment may have an air resistance of about 50 to about 90 as determined by the Gurley densometer.

The oil may be applied by means of the usual tub sizing equipment but I find a double sizing machine such as is used in the waterproof sandpaper industry very satisfactory. The entire coating of the oil may be applied to one side of the paper and allowed to penetrate more or less into and through the paper. I usually prefer to add some oil to both sides of the paper as by means of a double sizer, applying about two-thirds of the oil to the coat side of the paper and one-third of the oil treatment to the back side of the paper. By the coat side of the paper I mean the side to which abrasive grains will be subsequently attached by a suitable binder.

To render the heavy blown oil readily coatable, the viscosity is reduced by either heating or adding solvents such as Varnolene or by a combination of heating and solvents. A suitable temperature for the application of the oil or solu-

tion of the oil is 140° F. A satisfactory solution is 65% bean oil and 35% Varnolene. In this particular example about 30% of blown oil is added to the paper, the percentage being based upon the original weight of the paper stock.

After the oil is applied to the paper, the paper is passed to a drying room and festooned. It is held in the form of festoons and dried for a period of from about 4 to 24 hours at a temperature of about 130° F. to about 160° F. The paper is then taken down in the form of rolls and is ready for coating.

It is to be understood that the oil treatment specified may be used in addition to the wet strengthening agent or that merely one of these treatments may be employed.

As the next step in the operation I apply to the coat side of the paper, a binder such as that described in U. S. Patent No. 1,565,028 issued to Francis G. Okie dated December 8, 1925, or U. S. Reissue Patent No. 17,584, reissued February 4, 1930, to Francis G. Okie, or I may use more recently developed binders such as the oil modified glyptals or varnishes prepared by the dissolving of oil soluble phenolic resins in China-wood oil during the varnish making process. The viscosity of the binder used will vary with the grit size. It is usually advantageous to start with a viscous binder. A suitable viscosity for many purposes is a binder which tests body 0 when thinned to 60% with Varnolene or high flash naphtha, the viscosity being measured at a temperature of 77° F. with the Gardner-Holdt Viscometer. The base binder is thinned according to the grit size it is intended to coat, the coarse grits requiring thicker binder. By way of illustration, grit size 320 silicon carbide may be considered. For coating this grit, it will be found satisfactory to thin the base binder to 84% of "as received" and apply the binder to the paper at a temperature of 160° F. A suitable quantity of coat to apply with the usual calender rolls is 1½ lbs. per sandpaper ream. After the binder is applied, a layer of the grit is applied to the binder in any of the conventional ways but I prefer to use the new electrostatic methods disclosed in U. S. patents to Elmer C. Schacht, Nos. 2,027,307 and 2,027,309 dated January 7, 1936. After the grit has been applied, the coated web is carried into a conventional drying room and dried for a period of about 24 hours at a temperature of 150° to 170° F. After the first binder or making coat has been dried, a second or sizing coat of the binder is applied which may be the same or different material from that used as the first binder coat. In this case, however, it will be found advantageous to thin the binder to 65%. Suitable thinners as in the former case are Varnolene or high flash naphtha, the thinner used depending upon the exact binder selected. A suitable temperature for application of the sand sizing coat is 140° F. The sand sized coat is then dried for about 24 hours at a temperature of about 160° F.

If desired, by the use of a double sizer, a second backsize may be applied just before the sand size is applied, but in this case a very thin coat must be added to the paper to prevent sticking to the idler rolls used to carry the web to slats in the drying festoons which are customarily used in the manufacture of this type of sandpaper. After the sizing coat or coats have been thoroughly cured, the material may be taken from the racks in the form of rolls and later cut into the desired final forms for use, such for example as 9 x 11" sheets.

It will thus be seen that there has been provided by this invention an article and a method in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As various possible embodiments might be made of the mechanical features of the above invention and as the art herein described might be varied in various parts, all without departing from the scope of the invention, it is to be understood that all matter hereinbefore set forth is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. Waterproof sandpaper consisting of a paper backing having substantially uniformly distributed therethrough at least one agent to soften the backing, said agent being a water soluble polyhydric alcohol selected from the group consisting of glycerine, sorbitol and triethanolamine oleate, said softened backing having superimposed upon and being substantially uniformly penetrated throughout its area with a semi-drying oil, said semi-drying oil being in a separate phase from said softening agent, a waterproof binder for abrasive grains and abrasive grains held in said backing by said binder.

2. Waterproof sandpaper, including a paper backing sheet containing at least one agent to impart wet strength to the backing, said agent being a water-dispersible material insolubilized in situ, but in its insolubilized form being readily wetted by water and softened by water, and whereby the sheet softened by water has a substantially higher wet strength than a sheet not treated with said agent, said backing containing at least one agent adapted to soften the backing, said agent being a water soluble polyhydric alcohol selected from the group consisting of glycerine, sorbitol and triethanolamine oleate and said softened backing having superimposed upon and being substantially uniformly penetrated throughout its area with a semi-drying oil, said wet strength imparting agent and said softening agent being miscible with each other and said semi-drying oil constituting a separate phase from said wet strength imparting agent and said softener, a waterproof binder for abrasive grits, and abrasive grits held to said sheet by said binder.

3. Waterproof sandpaper, including a paper backing sheet containing a wet strength treatment of tanned glue, said glue being tanned or insolubilized in situ, but in its insolubilized form being readily wetted by water and softened by water and whereby the sheet softened by water has a substantially higher wet strength than a sheet not treated with said tanned glue, and a water soluble polyhydric alcohol softener for both said paper and said tanned glue selected from the group consisting of glycerine, sorbitol and triethanolamine oleate, and said softened backing having superimposed upon and being substantially uniformly penetrated throughout its area with a semi-drying oil, said tanned glue and said softening agent being mutually soluble in each other and said semi-drying oil being present in a phase separate from said tanned glue and said softening agent, a binder for abrasive grains, and abrasive grains held to said backing by said binder.

4. Sandpaper provided with a surface layer of

abrasive particles and comprising a base paper backing containing insolubilized glycerinated glue as a strengthening agent and having a water insoluble oil superimposed upon, and penetrating substantially uniformly throughout the area of, said base paper containing said insolubilized glycerinated glue, said water insoluble oil being immiscible with and existing in a separate phase from said insolubilized glycerinated glue, said treated paper carrying a waterproof binder coating comprising synthetic resin by which said abrasive particles are bonded to said base, said insolubilized glue being present in said base in an amount effective to increase vastly the wet strength of said base, said base containing said insolubilized glue being softened by said glycerine when dry but despite its content of said insolubilized glue and despite the presence of water insoluble oil being readily penetrated and further softened by water without significant effect on the bonding effectiveness of said bond coating on said particles, whereby said sandpaper may be soaked and flexibilized in water and does not tear or shed its abrasive particles in normal handling, bending and use.

5. Sandpaper provided with a surface layer of abrasive particles and comprising a base paper backing containing insolubilized glue as a strengthening agent and sorbitol as a softening agent for both the base paper backing and said insolubilized glue, and having a water insoluble oil superimposed upon and penetrating substantially uniformly throughout the area of said base paper containing said insolubilized glue and sorbitol, said insolubilized glue and said sorbitol being mutually soluble in each other and said water insoluble oil being insoluble in and existing as a separate phase from said insolubilized glue and said sorbitol, said treated paper carrying a waterproof binder coating comprising synthetic resin by which said abrasive particles are bonded to said base, said insolubilized glue being present in said base in an amount effective to increase vastly the wet strength of said base, said base containing said insolubilized glue being softened by said sorbitol when dry, but despite its content of said insolubilized glue and despite the presence of water insoluble oil, being readily penetrated and further softened by water without significant effect on the bonding effectiveness of said bond coating on said particles, whereby said sandpaper may be soaked and flexibilized in water and does not tear or shed its abrasive particles in normal handling, bending and use.

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