Patented Feb. 26, 1924. 1,484,759

UNITED STATES PATENT OFFICE.

FRANK JOSEPH CRUPI, OF BROOKLYN, NEW YORK, ASSIGNOR TO HERMAN BEHR & CO., INC., OF BROOKLYN, NEW YORK, A CORPORATION OF NEW YORK.

METHOD OF MAKING A WATERPROOF, FLEXIBLE, ABRASIVE-HOLDING COMPOSITION AND PRODUCT.

No Drawing. Application filed September 22, 1922. Serial No. 589,941.

To all whom it may concern:

Be it known that I, FRANK JOSEPH CRUPI, a subject of the King of Italy, and resident of Brooklyn, in the county of Kings and State of New York, U. S. A., have invented a certain new and useful Method of Making a Waterproof, Flexible, Abrasive-Holding Composition and Product, of which the following is a specification.

This invention relates to method of making a waterproof, flexible, abrasive-holding composition and product for use in making such articles of manufacture as abrasive sheets, discs, belts, wheels and the like, in which abrasive material is held on a backing of any suitable material. The backing is usually some appropriate fabric, such as paper or cloth or a combination of both, and for several years past there has been a growing demand for an abrasive material or cloth which is sufficiently waterproof to withstand disintegration when used on wet surfaces. This demand has become very extensive among finishers of painted or varnished surfaces where ordinary dry sandpapering is exceedingly unhealthful due to the poisonous nature of particles dislodged from the surfaces abraded. Many workmen who have inhaled such dust or other dislodged particles for considerable periods have suffered injuries and diseases of the lungs.

An object of my invention is to produce a waterproof abrasive article of manufacture adapted to withstand disintegration when used on wet surfaces, and constructed to hold both fine grade abrasive material and coarse grade abrasive material in place on the backing.

Heretofore, in using so called sandpapers, wetting of the abrasive and abraded surfaces has proved advantageous, not only because of the laying of the dust, but also because of the resultant effect of a better finish. However, ordinary sandpaper rapidly disintegrates when used on wet surfaces, and this disintegration of the material has always been objectionable. It is for these reasons that the extensive demand for waterproof sandpaper has arisen among sandpaper manufacturers, health bureaus and workmen.

For many years nothing could be found which was sufficiently waterproof and at the same time practical for holding both small and large grains of abrasives in place, though many attempts have been made so to do by the use of various compositions comprising rubber, varnishes, gums, waxes, cellulose compounds, oils, etc.

So far as I am advised no composition has been found prior to my invention whereby the coarser grains of abrasive can be properly held in a waterproof abrasive manufacture. However excellent the results of the kind in question have been with finer grains of abrasive, it is still true that great numbers of workmen who require coarse grain sandpapers are unprovided with waterproof, coarse grain sandpapers, for which the demand is insistent.

In the attempt to solve the serious and difficult problem above indicated, I have covered a wide field of research and made great numbers of experiments which have resulted in fine and coarse grain waterproof sandpapers that have been subjected to actual uses under working conditions and appear to solve the problem.

For some purposes but not for all purposes contemplated, the immediately appearing formula is a feature of my invention of a flexible, water resisting cement for holding abrasives in place:

	Lbs. avoirdupois.
Rosin	About 250
Glue	" 50
87% phenol (carbolic acid)	" 100
33% acetic acid	" 200

In connection with the work done under the above formula, I have constantly borne in mind the practical requirements of the art; that the product in question should be waterproof, cheap, tough and flexible, and preferably capable of being used with present manufacturing equipments. And I have recognized the difficulty with most compositions proposed in the prior art,—that while some of them were waterproof they lacked flexibility and toughness, and therefore could not hold the abrasive, while others were very tough and flexible but lacked the requisite waterproof qualities and therefore rapidly disintegrated in use. While this invention relates particularly to a method of making a composition or cement for the purpose of holding abrasives on backings as

well as to a composition or cement, I do not intend to limit the hereinafter appended claims to the use of the method and of the product for holding abrasives on backings. The present invention is intended to be claimed for any and all purposes.

I note now that the rosin element of my above and under mentioned formulæ is a practically perfect waterproof substance, but lacks toughness and flexibility, and that glue, on the other hand, possesses flexibility and toughness, but is not waterproof.

The formula which is the best form of my invention now known to me for use in holding abrasives on backings, and which has been developed on study and experiment relating to the chemical, theoretical and colloidal characteristics involved, is—

	Lbs. avoirdupois.
Rosin	250
87% phenol (carbolic acid)	75
Glue	60
Water	100
56% acetic acid	100
Benzine or benzene	5

In preparing the above compositions, the full quantity of rosin in powdered form is placed in a copper tank which is jacketed and equipped with a heating device. The phenol is then poured into the rosin and mixed well with it, the rosin being soluble in phenol. After allowing the phenol and rosin to soak for a short time, the heat is turned on in order to dissolve the rosin thoroughly, whereupon both ingredients react to form a rosin ester, in which case the rosin probably acts like an acid and the phenol like an alcohol. This solution will absorb a limited amount of water.

In a separate cortainer, I prepare a solution of glue, which is preferably hide glue, with the water and acetic acid specified in the formula. The glue is easily dissolved in the acetic acid and water volume by the aid of a little heat, and when so dissolved is poured into the solution of phenol and rosin, accompained by constant and rapid stirring.

The glue, acetic acid and water solution mixes with the rosin and phenol solution and upon coming in contact with the excess of phenol, over and above the phenol required to unite with the rosin, the glue is immediately reacted upon by the phenol and would coagulate were it not for the excess of the acids present which tend to reverse or prevent the coagulation. This combined mixture of the rosin solution and of the glue, water and acetic acid solution is insoluble to some extent in water, but it will absorb a limited amount of water and thicken very heavily, due to hydration of the colloids.

The carbolic acid in the mixture serves to reduce the surface tension between the glue and the rosin and causes a more thorough intermixture or emulsion of the whole colloidal system.

Now a solution of rosin, glue and phenol alone if spread on paper would take a long time to dry, and is not entirely satisfactory for application on backings.

It is desirable to use the least amount of phenol that is practicable because an unnecessary excess only serves as a detriment to drying and is, moreover, undesirably expensive. Consequently, in economic practice, it is actually a heavy or thick mixture that is formed, and such mixture requires a diluent.

I find that water is very objectionable as a diluent in this case because it thickens or raises the viscosity and also so affects the surface tension condition of the colloidal system as to impair its waterproof qualities.

And I have found that I can use acetic acid having a water content as a diluent because the presence of this acid tends to improve the surface tension condition and to keep the glue from jellying while it is being spread.

As the colloidal system exists now in this mixture of rosin, glue, phenol, acetic acid, and water, the union or intermixture of both phases, water-soluble and water-insoluble, is quite homogeneous and could be used with satisfaction, but I have found that the addition of a small amount of benzine (5 lbs.) still further improves the composition, in that it increases its waterproof qualities without appreciably diminishing the toughness and flexibility. This is due to the following change in the colloidal system.

Without the benzine, the water-insoluble phase, that is the rosin phase, is more the dispersed phase than the water-soluble phase, that is the glue phase, so that there exist in the colloidal solution particles of glue and particles of rosin minutely subdivided and intermixed. The glue particles, for the greater part, form the continuous phase and envelop the rosin particles. The greater the extent to which this condition is brought about, which can be done by adding excessive amounts of the water-soluble phase, or anything which will lower the surface tension of the water-soluble phase, the tougher or stronger the dried layer of the solution will be but the lower in waterproof qualities. If, on the other hand, the surface tension relations are raised, which can be done by adding excessive amounts of the water-insoluble phase or benzine, the condition will be reversed, i. e., the rosin particles, on account of the presence of the benzine, gain the upper hand and envelop the glue particles, the colloidal system then forming particles of

glue as the dispersed phase surrounded by particles of rosin as the continuous phase.

The resulting solution, when dry, is very waterproof, but not tough or flexible. So, briefly, it seems that when the glue phase predominates it envelops the rosin particles and naturally the glue being able to unite thoroughly throughout would dry very strong, but being exposed, since the rosin particles are on the inside, it is not very waterproof; and vice versa when the rosin phase predominates.

In order to bring about the most homogeneous distribution of both phases, I have found that only a small amount of benzine, such as I use in my formula, will, in this composition, serve beneficially to that end, the resulting product being a colloidal system homogeneous throughout with about as many glue particles surrounding rosin particles as rosin particles surrounding glue particles; and the result is waterproof, tough and flexible qualities.

To return to the acetic acid again, were I to eliminate it, or eliminate it beyond a limited extent, I would be confronted with the following phenomena. The solution upon being applied on the paper would immediately jell, which fact would cause an aggregation of the minute colloidal particles. In this stiffened condition, the mere force of spreading would break the globules open, so to speak. These would immediately set and harden in that condition without any of the beneficial colloidal homogeneity properties functioning.

The presence of acetic acid, on the other hand, keeps the solution fluid and homogeneous throughout, so that after the force exerted on the mass in spreading it has been removed, the solution will regain its original characteristics and dry accordingly. Therefore, it is obvious that each and every one of my ingredients has a specified importance in this composition.

To conclude, the whole solution as I have formulated and described it, is very stable and can be used at any time after being prepared. It will retain its chemical and physical properties, being a fluid while hot and a jelly when cold.

This solution as it is, can be used alone and be quite satisfactory, but I have found that a formaldehyde treatment, and finally a very thin coat of linseed oil will improve the qualities of the finished product considerably.

The process of manufacturing the waterproof paper, which I have found to be entirely successful, is as follows:

It has been found in the manual use of a waterproof abrasive paper on wet surfaces, that the back needs to be waterproof as well as the front, since the paper upon becoming wet will wear through very easily, due to the friction of the hand or fingers on the back of the paper with which it was being held. Therefore, the back of the paper is primarily coated with any cheap waterproofing compound that when wet will resist the pressure and friction of the fingers. For this purpose I have utilized a well-known reaction of glue with formaldehyde. This is done as follows:

The paper is passed through a coating-machine, which applies a coating of glue solution. While the glue on the paper is not yet entirely dry it is treated with a diluted solution of formaldehyde. This formaldehyde combines with the glue and the resulting dry layer forms a water-insoluble protection for the backing of the paper.

On account of its strength, and flexibility and convenience of making, I would rather use such material than wax, oil or varnish compositions.

After the back of the paper is so treated, it is passed through a coating-machine where it receives the usual coating of glue. Immediately following, is sprinkled into the layer of glue which is yet warm and plastic, the usual coating of abrasive material. The paper then travels along racks into a sizing machine. Here, instead of being sized with ordinary glue solution, it is sized with said waterproofing solution which is immediately sprayed wth a diluted formaldehyde solution.

The water-resistant composition enters the interspaces between the abrasive grains and its solvent action on glue causes it to unite with the underlying blue coat which primarily held the abrasive grains in place; and the united water-resistant composition and glue set as a tough, flexible, water-resistant binder or bond which holds the abrasive grains in place.

The purpose and advantage of spraying this water-resistant composition with a solution of formaldehyde are as follows:

The composition consists of two colloidal phases—the rosin phase and the glue phase. It is to be remembered that there exist glue particles which are exposed although not freely exposed. I have found that a piece of sandpaper made with this composition, but without the formaldehyde treatment, although it will last to a certain degree of satisfaction, the glue phase being not as water-resisting as the rosin phase, will begin to wear out under the strain of the friction and water. Such removal of the glue particles leaves an open framework or a porous structure of rosin particles, which alone cannot stand the further tension of friction, and rapidly disintegrate. So it being known that formaldehyde renders glue insoluble although not impervious, I thought of the following treatment which overcomes this condition. Although the glue particles of the

solution are perhaps softened due to a slight absorption of water, still they do not dissolve or wear out very easily, and consequently the whole waterproof structure is able to retain its lasting qualities.

Another advantage of this formaldehyde treatment is that upon immediately spraying or treating otherwise my waterproofing composition with formaldehyde, the formaldehyde quickly reacts on the glue phase of the colloidal composition and sets it or stiffens it so that it imprisons some of the solvents and retards their evaporation, thus imparting a degree of flexibility to the finished product.

After the application of this water-proofing composition, and the formaldehyde treatment, the product is dried. After drying it is given a final sizing of a ten per cent solution of boiled linseed oil in benzine. This is a very thin film which serves beneficially in that it strengthens the rosin or water-insoluble phase of the composition on the surface of the dried layer, and serves as an extra protection for the underlying basic waterproof and tough composition that holds the abrasive elements in place.

The product is then again dried and is ready to be used, the resulting product being a satisfactory, waterproof sandpaper possessing all the necessary qualities and being practically the first of its kind, and the only one yet made, so far as known, which fills all requirements of the trade.

It will be observed that the actual water content of each of the two formulas above specified is very nearly alike.

The product smells of carbolic acid and if the benzine and linseed oil solution is used as a final sizing, the product is further characterized by an oil film, in addition, of course, to solids.

What I claim is:

1. The method of producing a waterproof, flexible composition for holding abrasive material in place on abrasive articles of manufacture, and for other purposes consisting in dissolving rosin in phenol and thereby forming an acidulated solution capable of absorbing water to a limited extent and the acid in which serves to reduce the surface tension between the rosin and the hereinafter mentioned glue; and in mixing with such rosin-phenol solution an aqueous solution of glue having an acetic acid content which acts to minimize coagulation of the glue and to keep the mixture from jellying.

2. The method of producing a waterproof, flexible composition for holding abrasive material in place on abrasive articles of manufacture, and for other purposes consisting in dissolving rosin in phenol and thereby forming an acidulated solution capable of absorbing water to a limited extent and the acid in which it serves to reduce the surface tension between the rosin and the hereinafter mentioned glue; and in mixing with such rosin-phenol solution an aqueous solution of glue having an acetic acid content which acts to minimize coagulation of the glue and to keep the mixture from jellying; and in mixing benzine with the foregoing mixture for increasing the waterproof qualities of the compound without appreciably diminishing its toughness.

3. The method of making a composition of matter for use in holding abrasive material on backings, and for other purposes consisting in dissolving rosin in phenol under heat and thereby forming a rosin ester; in dissolving glue in water having an acetic acid content under heat; in mixing the aforesaid solutions and by the action of the acetic acid preventing coagulation of the glue and making the composition non-jellying in exposure of use.

4. The method of making a composition of matter for use in holding abrasive material on backings, and for other purposes consisting in dissolving rosin in phenol under heat and thereby forming a rosin ester; in dissolving glue in water having an acetic acid content under heat; in mixing the aforesaid solutions and by the action of the acetic acid preventing coagulation of the glue and making the composition non-jellying in exposure when used; and in adding benzine to the solution and thereby increasing in the composition rosin particles surrounded by glue particles and glue particles surrounded by rosin particles, whereby the waterproof qualities of the composition are enhanced.

5. A composition of matter for use in holding abrasive material on backings and for other purposes, comprising rosin, about 250 lbs. avoirdupois; glue, from about 50 to 60 lbs. avoirdupois; 87% phenol, from about 75 to 100 lbs. avoirdupois; acetic acid, from about 100 to 200 lbs. avoirdupois, according to its percentage; and water from about 66⅔ lbs. to 100 lbs. avoirdupois, according to the percent of the acetic acid.

6. A composition of matter for use in holding abrasive material on backings and for other purposes, comprising about 250 lbs. avoirdupois of rosin; about 75 lbs. avoirdupois of 87% phenol; about 60 lbs. avoirdupois of glue; about 100 lbs. avoirdupois of water; and about 100 lbs. avoirdupois of 56% acetic acid.

7. A composition of matter for use in holding abrasive material on backings and for other purposes, comprising rosin, about 250 lbs. avoirdupois; glue, from about 50 to 60 lbs. avoirdupois; 87% phenol, from about 75 to 100 lbs. avoirdupois; acetic acid, from about 100 to 200 lbs. avoirdupois, according to its percentage; and water from about 66⅔

lbs. to 100 lbs. avoirdupois, according to the percent of the acetic acid; and benzine, about 5 lbs. avoirdupois.

8. A composition of matter for use in holding abrasive material on backings and for other purposes, comprising about 250 lbs. avoirdupois of rosin; about 75 lbs. avoirdupois of 87% phenol; about 60 lbs. avoirdupois of glue; about 100 lbs. avoirdupois of water; and about 100 lbs. avoirdupois of 56% acetic acid; and benzine about 5 lbs. avoirdupois.

Signed at New York city, in the county of New York and State of New York, this 15 day of September, A. D. 1922.

FRANK JOSEPH CRUPI.