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IMPREGNATING PITCH AND PROCESS AND
PRODUCT UTILIZING ITIra H. Derby, Indianapolis, Ind., assignor to
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My invention relates to the impregnation of cellulosic fibrous material and products, such as paper, cloth, wood-pulp sheets and conduit, roofing paper, and fibrous insulating materials, as well as wood itself, with water-proofing compounds of pitchy character, such as coal-tar pitch, water-gas-tar pitch, and/or petroleum pitch, and various mixtures of pitches; to the process of impregnation involved; to the special impregnating materials used; and to the final impregnated materials, more especially impregnated conduit.

It is the object of my invention to increase the absorption of such pitchy material into the fibrous materials to be impregnated, so that a greater amount of the pitchy material may be taken into the pores of the fibrous material; to serve the multiple purpose of increasing the water-imperviousness, of increasing both the dielectric strength and the mechanical strength, of decreasing the lowering of dielectric strength under water-absorption conditions, and of improving the appearance of the treated material.

This invention is based on the discovery that the absorption of pitch by cellulosic fibrous materials may be markedly increased in rate and extent, and water-imperviousness promoted, by the conjoint use with the pitch to be absorbed of phenolic tar-acid. By phenolic tar-acid I mean such phenolic bodies as those which normally occur in coal-tar, and their analogs, homologs, and isomerides, whether of synthetic or other origin. That is, the tar-acids which I use in any particular case may actually be derived from other sources than coal-tar.

Among the phenolic tar-acids which are suitable, either in the crude or the refined state, are the following:

1. Phenol
2. Various composite tar-acids (from tar-acid oil)
3. Various cresylic acids
4. Ortho-cresol
5. Para-cresol
6. Meta-cresol
7. Mixtures of cresols, as of meta-cresol and para-cresol
8. Xylenols
9. High-boiling tar-acids
10. Low-temperature tar-acids
11. Ortho-phenyl-phenol
12. Alpha-naphthol
13. Beta-naphthol
14. Pyro-cresols
15. Various mixtures of the preceding phenolic tar-acids
16. Mixtures of oils with the tar-acids or with mixtures of tar-acids, whether the oil is a tar oil or some other kind of oil such as petroleum oil.

In carrying out my invention I may use any suitable impregnating pitch; and I use with it a phenolic tar-acid material such as referred to above. The pitch I prefer is a water-gas-tar pitch which melts between 50° and 80° C. The additional material may be mixed with the pitch, and the mixture applied as a unit in a single impregnating process; or the additional material may be preliminarily applied to the fibrous material to be impregnated, and the pitchy material applied subsequently. The temperature used for impregnation should be sufficiently high to make the impregnating materials flow fairly freely, and should be as high as conveniently possible without causing deterioration of either the treated or the treating materials. In practice, the impregnating temperature is well over 100° C., but usually under 200° C.; and for most pitches a satisfactory impregnating temperature is about 160° to 170° C. The impregnation may be made by simply soaking the fibrous material for a suitable time, or may be made under pressure to obtain greater penetration in shortened time.

I will describe my invention particularly with reference to the impregnation of electric conduits, of the type made of news-print paper-pulp or wood-pulp; and from that it will be clearly apparent how my invention is used on other types of cellulosic fibrous material.

These conduits are commonly from about 2 to 8 inches across, in length of from 3 to 12 feet, with walls of from $\frac{1}{8}$ inch to $\frac{3}{4}$ inch in thickness, or thereabouts. After being formed, these conduits are desirably dried before impregnation.

For many years it has been the custom to impregnate these conduits with pitch, by immersing them in a pitch bath for 7 or 8 hours and then allowing them to cool, with the pitch bath maintained at a temperature of about 150° to 185° C. The normal mean absorption of pitch has been in the neighborhood of 140% to 180% of the weight of the untreated conduit. A conduit so treated is fairly water-impervious, but not so much so as is to be desired. When tested for water absorption by being immersed in water at 21° C. for 48 hours the mean absorption of water is ordinarily found to be from 5% to 15% of the weight of the pitch-treated conduit. When such absorption of water occurs in a conduit in actual use, the resultant lowering of dielectric strength is very pronounced, amounting ordinarily to about 40% to 60%.

Instead of using the simple pitch that has heretofore been used for impregnation, I use such pitch together with some one or more of the phenolic tar-acids above referred to as the impregnating material. The quantity of tar-acid used may be relatively small in comparison to the quantity of pitch. In most instances it is

sufficient to use as little as from 1% to 3% tar-acid as reckoned on the weight of the pitch used; although in some instances it is desirable to use more tar-acid than that for best results, up to 8% or 10% in the case of beta-naphthol for instance, while in others it is possible to get good results with less, for instance as little as 0.2% in the case of crude composite tar-acids from tar-acid oil. In any case, it is desirable to use enough of the phenolic tar-acid to cause an increase in the total quantity of pitch which will be absorbed by the cellulosic fibrous material (the conduit) in a given time under specified conditions.

It is found that with conduit thus impregnated, so that a greater amount of pitch is absorbed, the water-imperiousness of the conduit is markedly increased over that of previously known conduits, the proportionate increase varying with the nature and amount of the tar-acids used. The pitch absorption by the use of the tar-acids may be increased by as much as 40% or 50% in some instances, over that of the unmodified pitch; and the mean water absorption of the conduit so impregnated with the modified pitch under the test for absorption by immersion in water for 48 hours at 21° C., may easily be reduced to below 3% of the weight of the treated conduit, and in most cases below 1% thereof. In many instances, with this water-absorption test, we have been able to get a mean absorption below 0.5% of the weight of the treated conduit. Thus the lowering of water-absorption under given conditions is of the order of 40% to 90%, and even more in some instances, as compared to previous commercial pitch-treated conduits.

The following table shows some results that were actually obtained by the use of water-gas-tar pitch melting between 50° C. and 80° C. and containing the indicated percentages of various phenolic tar-acids.

The material added to the pitch	Percentage absorption of treating material	Percentage water absorption in 48 hours at 21° C.
	Percent	Percent
0.5% crude composite tar-acids.....	228	0.32
1.0% crude composite tar-acids.....	251	0.27
2.0% crude composite tar-acids.....	271	0.15
2.0% ortho-cresol.....	223	0.24
2.0% para-cresol.....	226	0.40
2.0% high-boiling tar-acids.....	246	0.23
2.0% light-oil and tar-acid mixture.....	242	0.09
2.0% alpha-naphthol.....	248	0.05
4.0% phenol.....	228	0.7
2.0% crude composite tar-acids (4½ hour treatment).....	263	0.12
2.0% crude composite tar-acids (1 hour treatment).....	194	1.1

The treatments shown in the above table, except the last two, were all for 7¾ hours, the first 7 hours at 160° C. and the last ¾ hour at 182° C.; which conforms to standard practice in impregnating conduits. The last two lines of the table, however, show that in my process it is possible to use a shortened treatment, for there the treatments were for totals of only 4½ hours and 1 hour respectively, at 160° C.

Thus a marked increase in the amount of pitch absorbed, and/or a great saving in impregnating time, may be obtained in impregnating processes by the use of my modified pitch. The saving in impregnating time is especially marked when the impregnation is carried only to the extent of previous impregnations.

In the examples shown in the table given above the treatment is made by mixing the pitch and the indicated phenolic tar-acid, and impregnating the conduit in a single impregnating treatment. However, I have also gotten good results by treating the conduit first with the phenolic tar-acid and subsequently impregnating with the pitch. In the latter case, the treatment of the conduit with the tar-acid may be in any convenient way, as by dipping, brushing, or spraying, using either the tar-acid alone, the tar-acid dissolved in a solvent (such as benzol), or the tar-acid made into an emulsion (even with water). The amount of tar-acid used is so small in comparison to the pitch that when it is applied preliminarily it is not in sufficient amount to make a complete impregnation by itself of the treated material; but it somehow combines with and modifies the subsequently applied pitch so that the penetration of the latter is facilitated.

With the impregnation by modified pitch as above outlined, I not only get an increase in the amount of absorption of the treating material, and a decreased amount of water-absorption under similar water-exposure conditions, but I also get an increase in the dielectric strength of the conduit, an increased mechanical strength, a decrease in the proportionate lowering in dielectric strength under given water-exposure conditions, and an improved appearance. The surface of the conduit which has been treated with my modified pitch is usually a uniform lustrous black on both inner and outer surfaces, with a thin but even outer seal coating instead of the thick irregular outer coating seen in those previous conduits in which it has been sought to obtain a seal coat. If preferred, a dull surface may be obtained, for instance if phenol or meta-cresol is used as the pitch-modifying agent.

Although I have primarily described my invention for electric conduit, in which telephone or telegraph or similar conductors are placed, my invention is applicable to various other cellulosic fibrous materials. For instance, fabric insulation can be impregnated in the manner described above for conduit. So can wood; although it is desirable to dry the wood first, so that penetration into the wood may not be interfered with by moisture in the wood-pores. The wood that is treated may have been previously creosoted if desired. I have also used the same impregnating materials and processes for vegetable-fiber plates or sheets, such as various wall-boards, fibrous-base tiles, etc. These are merely examples of the materials to which my invention is applicable.

I claim as my invention:

1. The process of treating relatively inflexible prefabricated cellulosic fibrous material, which consists in impregnating it with water-gas-tar pitch containing from 0.2% to 10.0% of phenolic tar-acid.

2. An impregnating pitch of the class consisting of coal-tar pitch and water-gas-tar pitch, containing between 0.2% and 10.0% phenolic tar-acid, for impregnating relatively inflexible prefabricated cellulosic fibrous material such as conduit.

3. An impregnating pitch comprising water-gas-tar pitch melting between 50° and 80° C., to which has been added phenolic tar-acid, for impregnating relatively inflexible prefabricated cellulosic fibrous material such as conduit.

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