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MONOLITHIC STRUCTURE AND METHOD OF MAKING SAME.

No Drawing.

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This invention relates to monolithic structures and has for its object the provision of a method of producing such structures with a base of molded wood pulp. The invention also involves a new and improved wood pulp article having the characteristics of a highly mineralized substance which is very strong and not at all brittle.

The present invention contemplates a method of producing molded wood pulp articles having a substantially monolithic structure to render molded wood pulp articles better suited for their common uses, and moreover, to adapt them for uses for which they have been heretofore unsuitable. I have discovered that molded wood pulp articles, treated in accordance with the invention, are water proof and extremely resistant to acids and corrosive liquors. Moreover, such articles, thus treated, possess greatly superior strength and increased dielectric strength, without material decrease in resiliency.

The articles treated in accordance with the invention I prefer to call molded wood pulp articles. By molded wood pulp articles, I refer to articles formed in an appropriate manner within a fine mesh wire screen or the like from disintegrated wood pulp produced during the intermediate steps in the manufacture of paper. Such a wood pulp may be molded, cast or blown within a fine mesh wire screen in accordance with the usual customary method as is well understood in the art.

The invention involves impregnating the pores or interstices of the molded wood pulp article with sulfur and permitting the sulfur to congeal therein to obtain a relatively hard impervious mass of monolithic structure. Although sulfur is a brittle, relatively weak material, nevertheless, when the pores or interstices of the molded wood pulp article are impregnated with congealed sulfur, the strength of the resulting article is from five to eight times greater than that of the original article. By congealed sulfur, I mean sulfur which has solidified or congealed in situ in the interstices of a molded wood pulp article, the sulfur being initially introduced in the molten or liquid condition into the interstices.

I have discovered that molded wood pulp products of various forms and configurations are ideally adapted for impregnation

with molten sulfur, since they are extremely porous and may be made with walls of any reasonable thickness. In such articles, the absorption of molten sulfur amounts to many times the weight of the untreated article, but is usually from three to four times the original weight. After impregnation with sulfur, the finished product has a monolithic structure and may consist in some cases of as much as eighty-five per cent by weight of sulfur. This indicates that the molded wood pulp article simply serves as a carrier or vehicle for the sulfur and that the impregnated article is a radically different and new material. In other words, this processed wood pulp ceases to be a woody structure and takes on the characteristics of a highly mineralized substance which is, however, very strong, not at all brittle, and can not be likened to an article of similar form or configuration cast from sulfur alone. The molded wood pulp article impregnated with sulfur in accordance with the invention is from five to eight times stronger than the untreated material and is water proof, impervious and extremely resistant to the action of practically all destructive agencies, especially the various corrosive acids and other chemicals.

Various methods may be employed for impregnating molded wood pulp articles with sulfur in accordance with the invention. In order to secure the most satisfactory impregnation of the article with sulfur, the pores or interstices of the article must be freed of gases to permit filling of the pores with sulfur. When it is desired to impregnate relatively small molded wood pulp objects, they may be introduced, either with or without preheating, into a bath of molten sulfur at a temperature of about 120° C. at which temperature the sulfur is a relatively thin liquid. The molded wood pulp articles should be completely submerged in the bath, and, if necessary, means should be provided for holding them below the surface of the sulfur. I have found that it is sometimes desirable and advantageous to give the article to be impregnated a slight rotary movement in the molten sulfur bath. The temperature of the bath should be raised to expel the gases from the pores of the article. For this purpose, the temperature of the sulfur may be increased to about 220° C. at which temperature the sulfur approaches the

viscous stage. This causes the heat of the bath to penetrate well into the article and completely expel the air or other gases from its pores. After the gases have been thoroughly expelled, as indicated, by the reduction in the amount of gas bubbles coming to the surface of the bath, the temperature of the bath may be lowered until the sulfur again reaches the thin liquid stage. The gases now having been removed from the pores of the molded wood pulp articles, the thin liquid sulfur will gradually enter and fill the pores of the material. The impregnation of the articles with sulfur will generally be complete in from twelve to twenty-four hours, depending upon the size and shape of the object being impregnated. During this soaking period, it may be found advantageous to occasionally raise the temperature of the bath temporarily as this seems to aid in the impregnation.

When particularly complete impregnation is desired, great care should be paid to the manner of withdrawing the article from the bath. For example, both the bath and the article should be allowed to cool until when a surface of the article is lifted from contact with the bath, the sulfur thereon begins to show indications of congealing. Then the article is slowly withdrawn from the bath and the sulfur on the surface of the article begins to congeal during the operation. It is sometimes advantageous and desirable when withdrawing the article from the sulfur bath, to subject the article to the action of a cold air blast of moderate intensity and this assists in properly congealing the sulfur and prevents the escape of a portion of the sulfur from the pores of the article.

The improved physical and chemical properties imparted to molded wood pulp articles treated in accordance with the invention render the article more suitable for its common uses, and open a great variety of fields of utility for fibrous articles where they have been heretofore utterly unadapted for use. The article may be used in locations where it is subjected to moisture and dampness without danger of warping and distortion. Molded wood pulp articles, so treated, are from five to eight times stronger than the original unimpregnated article without substantial change in resiliency. The new improved product of the invention is not only wet-resistant but water proof and is extremely resistant to acids and corrosive liquids. I have found that containers made from molded wood pulp subsequently impregnated with sulfur will withstand the action of 15% acetic acid, 20% phosphoric acid, mixtures of ferrous and ferric chloride, 20% hydrochloric acid, 19% nitric acid, 14% sulfuric acid and even of hydrofluoric acid. I have found that molded wood pulp articles of appropriate configuration and treated in

accordance with the invention are adapted for use as battery jars, forming tanks, electrolytic cells, textile cones and for many other purposes requiring great strength and resistance to chemicals. Such articles fulfill to a remarkable degree the requirements of their particular uses.

I have also discovered that this new material, consisting of molded wood pulp as a base with crystalline sulfur permeating throughout its mass and occupying substantially every fiber and void, may be given an excellent finish by sanding and polishing. This finish has the appearance of old ivory. If desired, many attractive colors may be imparted to the molded wood pulp article by incorporating such colors, either in the form of a pigment or certain organic dyes, in the sulfur bath and thereby carrying them into the molded wood pulp article during impregnation. This is notably the case with iodine.

I am aware that it has been suggested heretofore to impregnate paper with sulfur. I have found, however, that when paper is impregnated with sulfur in accordance with these prior suggestions, it becomes extremely brittle and cannot be bent. For all practical purposes, the paper is actually weakened by the process, and on account of its extreme brittleness, it cannot be used for the making of containers or other products which require a high degree of pliability in the manufacturing process. I have discovered, however, that molded wood pulp articles of the type heretofore described, when impregnated with congealed sulfur in accordance with the invention, become in effect a monolithic structure, comprising a mass of sulfur reinforced throughout by wood pulp fibers which give it great strength and serve as a base to produce different forms and shapes which cannot be made in any other way, and possess other advantageous properties as heretofore set forth.

I claim:

1. The method of producing an article having a substantially monolithic structure which comprises immersing a porous article in a bath of molten sulfur, maintaining the article in the bath until the interstices of the article are impregnated to the desired extent with the sulfur, then lowering the temperature of the molten sulfur until it shows indications of congealing, and subsequently withdrawing the sulfur-impregnated article from the bath of molten sulfur in a manner that the sulfur in the interstices thereof congeals in situ.

2. The method of producing an article having a substantially monolithic structure which comprises immersing a molded wood pulp article in a bath of molten sulfur at a temperature below that which would partially carbonize the wood, maintaining the

article in the bath until the interstices of the article are impregnated to the desired extent with sulfur, then lowering the temperature of the molten sulfur until it shows indications of congealing, and subsequently withdrawing the sulfur-impregnating article from the bath of molten sulfur in a manner that the sulfur in the interstices thereof congeals in situ.

3. The method of producing an article having a substantially monolithic structure which comprises immersing a porous article in a bath of molten sulfur, raising the temperature of the molten sulfur to assist in removing gases from the pores of the article, thereafter reducing the temperature of the sulfur to a point only slightly above the melting temperature of the sulfur, maintaining the article in the sulfur at the reduced temperature until the interstices thereof become impregnated to the desired extent, then further reducing the temperature of the sulfur until it shows indications of congealing, and subsequently withdrawing the sulfur-impregnated article from the bath of molten sulfur in a manner that the sulfur in the interstices thereof congeals in situ.

4. The method of producing an article having a substantially monolithic structure which comprises immersing a molded wood pulp article in a bath of molten sulfur, maintaining the article in the bath until the interstices of the article are impregnated to the desired extent with the sulfur, then lowering the temperature of the molten sulfur until it shows indications of congealing, and subsequently withdrawing the sulfur-impregnated article from the bath of molten sulfur in a manner that the sulfur in the interstices thereof congeals in situ.

5. The method of producing an article having a substantially monolithic structure which comprises immersing a molded wood pulp article in a bath of molten sulfur at a temperature below that which would partially carbonize the wood, maintaining the

article in the bath until the interstices thereof are impregnated to the desired extent with sulfur, then lowering the temperature of the molten sulfur until it shows indications of congealing and subsequently withdrawing the sulfur-impregnated article from the bath of molten sulfur and expediting the congealment of the sulfur to prevent the escape of a portion of the sulfur from the pores of the article.

6. The method of producing an article having a substantially monolithic structure which comprises immersing a porous article in a bath of molten sulfur, raising the temperature of the sulfur to assist in removing gases from the pores of the article, thereafter reducing the temperature of the sulfur to a point only slightly above the melting temperature of the sulfur, maintaining the article in the sulfur at the reduced temperature until the interstices thereof become impregnated to the desired extent, then further reducing the temperature of the sulfur until it shows indications of congealing and subsequently withdrawing the sulfur-impregnated article from the bath of molten sulfur and expediting the congealment of the sulfur to prevent the escape of a portion of the sulfur from the pores of the article.

7. The method of producing an article having a substantially monolithic structure which comprises immersing a porous article in a bath of molten sulfur, maintaining the article in the bath until the interstices thereof are impregnated to the desired extent with sulfur, then lowering the temperature of the molten sulfur until it shows indications of congealing and subsequently withdrawing the sulfur-impregnated article from the bath of molten sulfur and subjecting it to the action of a cold air blast to expedite the congealment of the sulfur and prevent the escape of a portion of the sulfur from the pores of the article.

In testimony whereof I affix my signature.

WILLIAM HOFFMAN KOBBE.