ANTIMICROBIAL PAPER

BACKGROUND OF THE PRESENT INVENTION

The production of antimicrobial paper has generally been accomplished by producing the desired paper in sheet form and then coating the sheet with an antimicrobial coating to inhibit growth of fungi and bacteria thereon. Kraft paper, which is a strong paper made from a sulfate-process woodpulp and frequently used for wrapping paper and shipping cartons, has also been utilized as wrapping paper for surgical instruments and other types of goods which are to be maintained in a sterile condition. When these kraft papers are used for the wrapping of surgical instruments, they are conventionally formed or made in a process that involves brushing the pulp fiber in mixed directions so that the arrangement of fibers creates a tortuous path for any microorganism that attempts to pass through the paper. Upon completion of the paper product the paper is coated with some type of antibacterial or antimicrobial coating to further inhibit the passage of microorganisms from the exterior surfaces of the paper onto the sterile goods packaged therein.

U.S. Pat. No. 2,833,669 is directed to a cellulosic paper material of the type used for medical, industrial, hygenic and other such purposes. This patent discloses the use of a bactericidal coating having a particular affinity for fibrous substances, which coating is spread across the paper product at a point in the procedure just before the fibrous web has been subjected to a drying process. The patent further discloses that the bactericidal layer may be applied to one or both sides of the fibrous web. This patent is somewhat typical of the processes known to exist for producing antimicrobial papers.

The problems inherent in these known processes involve the fact that such coatings are easily rubbed off or otherwise destroyed by unsuitable storage or shipping. Once the coating has been destroyed, there is no further antibacterial action to protect the paper or to inhibit microorganism growth.

It is to overcoming these known deficiencies through the development of an improved antimicrobial paper that the present invention is directed. Modern paper products are generally manufactured from a mixture of various fibers, chiefly of vegetable or cellulosic origin, which fibers are mixed with large quantities of water before being shredded to a very fine consistency. This fibrous mixture is then treated with sizing, a glue-type mixture which makes the finished product water resistant, and fillers such as clay or chalk which are added to give special properties to the paper. In production of the heavier papers such as kraft-type, the basic cellulosic mixture is further subjected to bleaching, pounding and refining, and brushing steps to ensure that the sizing material is deposited almost entirely on the fibrous constitutents and not lost through drainage of water when the material is poured out on screens for the dewatering, pressing, drying, and calendering steps. Further additions to kraft-type papers are binding agents and fillers which improve the color and surface characteristics of the finished paper.

As previously mentioned, the brushing step has been one of the primary methods of improving the ability of the paper to withstand penetration by microorganisms. Another method has been to substantially increase the percentage of binders such as latex, silicone or acrylic materials. The increased percentage of binder closes the spaces between the fibrous material, making it less permeable by microorganisms. However, the brushing step and the increased percentage of binder, both of which are frequently used in the same process, significantly increase the cost of producing the paper.

It has been discovered that the present invention, in addition to improving the antimicrobial characteristics of the paper, also results in a substantial savings in the cost of production by eliminating the need for the brushing operation and/or the increased binder concentration. In the present invention an antimicrobial additive is selected for compatibility with the desired end product and is added to the latex or other binder used in the paper product. The antimicrobial additive is of a type chosen for compatibility with the binder such that it resides in collidal suspension with the amorphous zones of the polymer rather than being cross-linked with the polymer. The result is that reservoirs of antimicrobial additive are established in these amorphous zones and is available to continuously replenish the surface of the paper product as the initial deposits on the surface be utilized or destroyed. Since the additive is in free suspension within the binder, it has the capability of migrating onto adjacent fibers and to the surface of the paper to more uniformly treat and therefore more completely inhibit the growth of bacteria and fungi. The migratory effect of the antimicrobial additive as suspended in the latex or polymer binder has been fully discussed in applicant's prior patents, U.S. Pat. Nos. 3,959,556, 4,343,853, and 4,401,712. The most recent of these patents, U.S. Pat. No. 4,401,712, contains a discussion of the migratory effect as used within a textile material and the entire content of that patent is incorporated by reference herein.

In addition to a kraft-type paper that is inherently antimicrobial throughout, and in addition to the substantial savings in production costs, a further benefit of the present invention is an improved printability of the kraft paper. Historically, kraft papers have been poorly receptive to printing ink because of the high quantities of binder and filler material used therein. The increased concentration of binders and fillers which make the kraft paper substantially water and moisture resistant, and the additional antimicrobial coatings thereon, also make the papers even more resistant to printing processes. Because the antimicrobial additive of the present invention allows for decreasing the percentage of binder used in the paper without decreasing its antibacterial qualities, the resulting paper is substantially more receptive to printing inks.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

The paper formed according to the present invention may be any of a variety of types of paper, made according to a variety of conventional paper forming processes. However, for example, and because a kraft-type paper is traditionally used for packaging surgical instruments and other sterilized materials, this detailed description generally will be directed to the production of a heavy-duty, kraft paper. The kraft process is one generally known as a sulfate pulping process, a wood-pulping process in which sodium sulfate is used in the caustic soda pulp digestion liquor. The resulting paper made by the sulfate pulping processing cannot generally be bleached as white as that made by a soda or sulfite