Patented Nov. 27, 1945

2,389,678

UNITED STATES PATENT OFFICE

2,389,678

POWDER FIBER SHEET

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Application February 5, 1943, Serial No. 474,885

1 Claim. (Cl. 92—3)

This invention relates to a strong flexible sheet consisting of mineral matter and cellulose, the proportion of mineral matter being much greater than ordinarily attained in such combinations and useful where the properties of the mineral matter are of particular value without essential loss of the flexibility, porosity and strength of the sheet.

Hitherto, it has not been possible to form a strong and flexible sheet with the high percentage by weight of mineral filler contained by the sheet of this invention. The reason for this is that the fillers, usually employed, consist of particles so shaped that they do not attach themselves to the paper fibers or to one another, but merely fill the interstices between the fibers in the sheet. Thus, they prevent the tight interlocking of fibrils and do not provide mutual interlocking of particles which are necessary for the realization of a strong flexible sheet, and in themselves offer no contribution to the development of strength.

An investigation of papers, made with a great variety of fillers, by means of an electron microscope, revealed that the essential quality required of a filler to make a high tensile strength sheet is a burr-like particle. Such a particle is capable of engaging with the multitudinous fibrils of paper fiber and with like particles, thereby virtually forming part of the essential structure of the sheet.

In order to attain a maximum structural integration, it was also found necessary to employ a filler of particle size suitably related to the dimensions of paper fiber fibrils, which exhibit diameters ranging approximately from 0.1 to 1.0 microns.

Such a filler was found in a new form of silicon carbide, namely, submicroscopic silicon carbide. This carbide may be obtained as a submicroscopic particle, which when viewed with the aid of an electron microscope is revealed as skeletal crystallite, having the appearance of a pile of jackstraws. The maximum overall dimension of a particle or crystallite of submicroscopic silicon carbide is approximately one micron, each of the component straws or appendages being approximately ten times as long as they are across. These intertwine, and entwine with the wood pulp fibrils, so as to form the sought for sheet. The electron microscope has been employed to study the efficient manner in which these particles adhere to paper fiber and to one another.

The foregoing and other features of my invention will now be described in connection with the accompanying drawing forming part of this specification, after which I shall point out in the claim those features which I believe to be new and of my own invention.

In the drawing, Figure 1 is a diagrammatic view of the elements of my powder fiber sheet on a scale of approximately 50,000 to 1 showing a fiber fibril and particles of powder.

I have not attempted to illustrate the powder en masse, as it appears with the aid of an electron microscope. It there has the appearance of a pile of jack-straws with efficient interwining of the skeletal crystallite structure of the particles. Sufficient for this disclosure I show a fibril 11 of a cellulose fiber and three skeletal crystallites 12, 13, 14, mutually interwined and entwined with the fibril.

Other special carbides and carboxides of metals of the same group in the periodic table, such as titanium, have been found to possess characteristics similar to those of submicroscopic silicon carbide, but to be less suited than the latter because of their larger particle size, which approximates 5 to 10 microns.

Undercooked sulphate wood pulp is the preferred source of fiber for the supporting mesh of the sheet. Such pulp mixed with the filler powder is beaten to a slowness of 300 to 400 cc., which is considerably less than the 500 cc. or more, ordinarily used to obtain maximum tensile strength.

Beating to a slowness of 300 cc., not only develops the strength of the loaded sheet, but also greatly enhances the powder retention characteristic of the fiber mesh due to the high order of fibrillation or pile obtained thereby. Thus, with a furnish of four parts powder, by weight, to one part air-dry pulp, the sheet made with pulp beaten to a slowness of 300 cc., consists of 51 percent powder and 49 percent pulp by weight, whereas at 500 cc., the sheet consists of 37 percent powder by weight and 63 percent pulp.

An interesting characteristic of the sheet, which is the subject of this invention, is its high porosity, or as ordinarily expressed, its low Gurley density, a valuable characteristic in some of the arts. Ordinarily a high filler content means a high Gurley density. The sheet made as described above, however, is characterized by a very low Gurley density, i. e., 48 seconds as compared with 200 seconds for a normal sheet made solely with the same pulp. It is, of course, possible to obtain higher density by any of the means commonly employed for this purpose in the art of paper making.

I wish it distinctly understood that my powder