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DELAMINATED DOMESTIC SEDIMENTARY CLAY PRODUCTS AND METHOD OF PREPARATION THEREOF

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This invention relates to improvements in domestic sedimentary clay products for coating and other uses, and includes new clay products with distinctive particle size, shape and distribution, of high brightness and whiteness and improved gloss, and an improved process of producing them.

This application is a continuation-in-part of our prior applications Serial No. 778,030, filed December 3, 1958, and Serial No. 809,125, filed April 27, 1959, both abandoned.

Domestic coating clays, used extensively in the paper industry, are made from Georgia sedimentary kaolin clays by settling or separation treatments which remove from the clay the grit and coarser particles above a predetermined size. High grade coating clays are made by separating coarser clay fractions so that the coating clay will contain around 80% or 90% of particles less than 2 microns in size.

Domestic clays are sedimentary clays and are distinguished from English clays which are primary clays imported from England. When English clays are referred to, it will be understood that they are primary clays, and when domestic or Georgia kaolin clays are referred to, it will be understood that they are domestic sedimentary clays.

Such domestic coating clays are sold in competition with imported English clays which find ready acceptance because of their brightness advantage, generally 1 to 3 points over domestic coating clays, and particularly because of the whiter appearance which they impart to a filled or coated sheet. English clays thus frequently have a G.E. brightness of 90 or more, whereas the highest values obtained with domestic coating clays, even after bleaching, are generally 1 to 3 points or more lower than 90.

English clays have a distinctive white color and give a coated paper sheet with a white color, whereas domestic clays will give a yellow-white or cream-colored sheet when compared to the sheet made with English clay. This difference is readily observable to the eye. The papermaker can add blue dyes to the coating color formulation (made up of clay plus a binder such as casein or starch plus additives) and thus obtain the desired blue-white or less yellow sheet of paper, but in doing so the brightness of the sheet is decreased.

Because of the advantages of brightness and color, many paper mills use the English clays, even though in some respects, such as their poor rheological characteristics, they have less desirable properties.

It is well known, in fact is the basis of determining grades, that finer particles size distribution improves the paper coating characteristics of clay. Thus, in both the English and domestic clay industry, several grades of coating clays are produced and the particular grade is determined primarily by the percent of particles below two microns in size. A #1 coating grade of clay (English or domestic) will generally have 90–100% of its particles below two microns, a #2 coating grade will have 80–85% of its particles below two microns and a #3 coating grade will contain perhaps 70% of its particles below two microns. A clay that contains 55% or less of its particles below two microns, is generally sold as a filler clay, although there is some overlapping in these fields. In

fact, the highest grade coating clays may sometimes be used as fillers while a relatively coarse filler clay may sometimes be used as a coating pigment. The production of the finer particle sized grades is expensive, since much (30–70%) of the starting clay is of coarser particle size and, therefore, is either discarded or, more generally, is sold at a low price as filler clay.

It is generally considered, in the coating clay industry, that there is a critical value of about 2 microns for clay particles, that is, clay particles below 2 microns are predominantly single, flat, hexagonal plates, while clay particles coarser than 2 microns are strongly bound stacks or aggregates. The particle sizing of clay is commonly effected by the so-called sedimentation method, and the size of the clay particles is expressed in terms of equivalent spherical diameter, as determined by this method. Electron-micrographic methods are stated to confirm these results. See TAPPI Monograph Series, No. 20, "Paper Coating Pigments," published 1958, pp. 71–77; Kirk Othmer, "Encyclopedia of Chemical Technology," published 1949, vol. 4, pp. 65, 68.

It is also recognized that the platelets of around 2 microns in size and smaller have a thickness of around $\frac{1}{10}$ their diameter, but that particles above 2 microns are not platelets but are aggregates or stacks which are much more nearly isometric in shape than the single plate particles and are present as so-called "stacks" or "booklets" or aggregates (TAPPI reference, supra, pages 73–75).

The present invention provides an improved domestic sedimentary clay for coating or other purposes with a G.E. brightness of the unbleached product of 88 or higher, and of the bleached product of 90 or higher, and with a white color comparable with that of British clays, as well as with improved gloss and other desirable properties. The new clay, on calcination, gives a calcined clay of unusually high brightness of about 95 to 99, and a remarkably low abrasion index of below 100.

A particularly valuable delaminated product is produced by the delamination of coarse filler clays, made up largely of stacks or booklets, and containing not only platelets of less than 2 microns in size but substantial amounts of larger platelets up to and above 5 microns in size, by electron micrographic measurement, and which have unusual properties, as hereinafter pointed out.

An improved domestic coating clay product is made by subjecting conventional sedimentary coating clays to delamination to produce coating clay products which are distinguished from conventional products by the absence of stacks or booklets of more than 2 microns in size, and by the presence of thin platelets of more than 2 microns in size.

Some of the properties of the new delaminated products produced depend with the particular starting materials which are subjected to delamination.

When the new delaminated clay products are produced by subjecting coarser domestic filler clay fractions, made up principally or largely of booklets or aggregates, to delamination, the resulting delaminated products contain considerable proportions of large platelets of more than 2 microns in size, and also more than 5 microns in size, and with a thickness of these larger platelets of around 0.2 to 0.4 micron, by electron micrographic measurement. In producing such products, the starting materials of the present process are coarse Georgia sedimentary kaolin clay fractions composed in the main of booklets or aggregates of clay platelets. Such coarse clay fractions are obtainable in the process of milling clay after first separating the sand and grit and coarser particles and after further separating the clay to remove most of the finer clay particles therefrom. These coarser fractions may contain small amounts of clay of less than 2