SOME FACTS REGARDING PRESENT FOAM LATEX TECHNOLOGY AS RELATED TO MINERAL FILLERS

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Background

In light of requests for technical information directed to the Minerals Research Laboratory regarding consumer standards for feldspar used as foam latex filler, it was considered expedient for the MRL to have some basic information in this area. Mr. Smith of Dayco was most cooperative in granting some conference time on this subject, on October 1, 1969.

Foam Latex Production Processes

Mr. Smith stated that there are now two processes employed in foam latex technology:

1) the Dunlop process, used principally for coatings and backings, as on carpets, etc.
2) the Talalay process, used for cushions, pillows, mattresses, etc.

In the Dunlop process, the latex is mixed with curing reagents plus filler and flowed into an Oakes foaming machine which agitates it while adding air, thus creating a wet latex foam. This wet foam is spread mechanically at a given depth upon the desired article,

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*A report on a technical conference with Mr. Howard Smith, Supervisor, Foam Laboratory, Dayco Corporation, Waynesville, N. C.

which is then passed through a heated area, by which the latex backing is dried and fully vulcanized. There must be a close synchronization between downward pH drift of the latex and the foaming and spreading process. When the pH, which initially is about 11, is reduced to about 7, the formulation "sets," even prior to heating. Gelling and other agents which reduce pH or control the reduction rate must be carefully added within a narrow time margin before foaming and spreading.

Prior to foaming and spreading, it is advantageous to have the latex formulation stored on hand, ready for use except for adding some reagents which are directly involved in the pH drop. This also provides a "maturing" period, considered beneficial. During this storage period it is essential that pH of the latex remain stable. Fine ground feldspar is acceptable as a filler in Dunlop-process foam latex because it seems to have no effect on the pH stability. Presumably, the same can not be said regarding fine-ground quartz, or perhaps the quartz alters the rate of pH drift when the foaming and gelling cycle begins.

The Talalay process, more recently developed, involves a radically different procedure tailored for different products. Here, formulated batches of latex compound are made up only six to eight hours in advance of the foaming (also done by Oakes foamer). The foam in this case is made denser than in the Dunlop process; that is, with less entrained air. Enough foam is poured into a mold to fill only about one-third of its volume. The mold, which is precision-made, is closed and sealed, then evacuated, causing the foam to expand and fill the entire space. Next, cold brine at minus 25^{o}F is circulated through passages in the mold walls, freezing the expanded foam. This causes a unique phenomenon:

the latex boundaries between air spaces are breached, creating a foam consisting of tiny latex films interconnected by small holes. This situation then permits the next step: introduction of CO_2 under pressure into the foam to "set" it. Finally, vulcanization is carried out by running hot brine at 225°F into the wall passages of the mold ("Ultra-accelerators" are employed to permit vulcanization at this relatively low temperature). Complete, the formed, vulcanized foam is removed from the mold and put through a washing and drying process.

In the Talalay process, fine-ground quartz has no adverse effect such as that described for the Dunlop process, and so can be used pound for pound in place of feldspar, with a saving in materials cost.

Standards for Fillers

Since Dayco now uses only the Talalay process and consequently only fine-ground silica, it will be necessary to obtain standards on feldspar filler elsewhere. Regarding silica filler, the following facts appear pertinent: the present source of supply furnishes essentially minus 200 mesh silica for about $11.00 per ton. It has color-reflectance values in the 90's, and Fe_2O_3 assay of about 0.03 percent. The product has no material coarser than 100 mesh, and this is important, since plus 100 mesh particles would create quality problems. Color and Fe_2O_3 specifications given are those of the supplier and they are adequate. Minimum specifications on these have not been established or stated by the user, although light color is desirable to make the finished product visually acceptable; and the presence of copper, manganese, or iron is to be strongly avoided. The particle shape of the silica now used appears to be generally uneven and jagged. There are no particle shape specifications. If the filler contains too many extra-fines (below perhaps one or two microns), the amount of soap (potassium oleate) in the formulation must be increased, and this is not welcome.

Acceptance of Trial Samples

Mr. Smith indicated strongly that he is glad to accept sample quantities of new, different, or unique mineral fillers to try out in foam latex. The Company maintains a foam research laboratory which can establish the general characteristics of Talalay foams incorporating such trial fillers. Generally, an initial quantity of about five pounds is enough.

Evaluation of Foam Latex

One means of judging latex foam quality is by "compression index." Dr. Talalay, developer of the process bearing his name, established compression characteristics of a series of natural-rubber latex foams of standard formulation but of varying densities (weight vs. volume) by applying enough pressure per square inch to each pure foam standard sample (of constant depth) to depress that sample by 25 percent of depth; and recording a curve based on applied weight required for the 25 percent compression versus density. The points on this curve were then all given a "compression index" value of one hundred. Based on this, a trial latex swatch of any density can be assigned a compression index. If double the pressure is required (to compress 25 percent) compared to the standard of equal density, the compression index is 200, and the trial swatch is a qualitative improvement in that respect. Siliceous fillers (quartz and feldspar) raise compression index to 200-250. This system of evaluation is well-suited to a flexible product sold by volume rather than by weight.

Trial of Other Fillers

Research has been performed on certain other mineral fillers in foam latex, among them North Carolina talc and Canadian asbestos, both in fine size range. Of the two, talc is presently more interesting, possibly because more research has been done on it. Fine talc as filler imparts to the foam not only a much higher compression index (400-500), but also increased tear resistance (reinforcing), which siliceous fillers do not contribute. In order to add the latter characteristic, however, an appreciable portion of the talc must be in the particle size range of 5 microns or less. As talc particle size increases, the reinforcing characteristic diminishes, disappearing completely at 20 microns. The reinforcing characteristic is well worth having, even with need for use of more soap. However, the preventing obstacle here is failure to strip from the mold after casting. Various experimental measures have so far not been successful in overcoming this, but the idea will undoubtedly be pursued further. Fine-ground mica exhibits somewhat the same characteristics as talc. So does carbon black in the right size range, but because of its color it has not been fully researched as to mold stripping. Asbestos, when tried in one instance, proved disappointing, but would be acceptable for further tests.

Possible Trends

Mr. Smith expressed the belief that esthetic considerations on the part of consumers are a principal factor in establishing light color standards for foam latex fillers. If this consideration could be avoided by offering a special product whose color was indicative of special function or quality, then other fillers might be surveyed. Mr. Smith emphasized a final point: that with the present strong trend, pushed by government, toward consumer goods which are fireproof or flame-retardant, there may appear some profound changes in foam technology, involving new polymer structures, which in turn could change the picture regarding mineral fillers.

Other Sources of Information

Thomas' Register lists several corporations which supply mineral fillers of various sorts for use in rubber, paint, etc. (See FILLERS, MINERAL). A contact with one of these might be of value. A second recommended source of information is a book entitled Materials and Compounding Ingredients for Rubber, published by Bill Publishing Company.