DOI: 10.1017/S1431927603442281
Microsc Microanal 9(Suppl 2), 2003

SEM characterization of the interrelation between particle and matrix in rubbers with $CaCO_3$ fillers.

C. Lariot*, O. Reinosa**, R.C.R. Nunes***.

*Science Material Group of Electron Microscopy Laboratory. National Centre for Scientific Research (CNIC). P.O. Box 6414. Havana. Cuba. odelsa@infomed.sld.cu
**Aging and Stabilization of Polymeric Materials Laboratory. CNIC.
***Macromolecules Institute "Eloisa Mano" (IMA) U.F.R.J. Río de Janeiro. Brazil.

Fillers strongly change the properties of polymeric materials. The incorporation effect for an specific filler depend principally on the interaction between filler and the polymeric matrix in the interface [1]. Changes in the properties of rubbers due to fillers incorporation can be seen in the physicomechanical and electrical tests. This tests brings indirect determinations of the fillers action and also may arrives to some considerations about particle-matrix interface characteristics, but do not permit the best characterisation that is necessary for the development of new fillers treating the intrinsic particles or the particle surface. SEM studies of the cold fracture surface of rubbers permits comparative analysis that shows the degree of modification in elasticity and other properties due to addition of different fillers and specially, in a very graphical way, the analysis of the interaction between the particle and the matrix in the interface that determines the material behavior against fracture strains and in general against other external strains to be submitted during their work [2].

In the study of the reinforced effect of Cuban and Brazilian calcium carbonate fillers, treated or not with stearic acid, on rubber composites with natural Brazilian or styrene-butadiene synthetic rubber, SEM was employed to complete the obtained data in tension strength tests, rheometric analysis at 150° C of rubber compositions after milling their components and at 50° C during milling; and also isothermal adsorption at liquid nitrogen temperature. These analyses showed the reinforced effect of two employed fillers [3]. It was determined that particle size is similar in both carbonates (between 1 and 12 µm for the Cuban carbonate and between 1 and 15 µm for the Brazilian), but different in morphology: particles of the Cuban carbonate have smoother and more regular surfaces and more crystalline appearance (Fig. 1, 2). Cold fracture surfaces of natural rubber shows more striated rupture faces and better matrix covering of the particles (Fig. 3) than synthetic rubber. The later showed higher quantity of holes free of particles that shows a worse adhesion to the matrix (Fig. 4). These results are in accordance with higher tear test parameters showed by the natural rubber. Moreover, in general the Cuban carbonate particles have higher aggregation tendency (Fig. 5,6).

[1] J. Jancar et al. Mineral fillers in thermoplastics. Row materials and processing. Cap. I. Adhesion and Surface Modification. Springer-Verlag Heidelberg. New York, (1999) 110.
[2] C. Lariot et al. Rev. CENIC. Cienc. Quím., 32, 2, (2001), 77.
[3] O. Reinosa et al. Rev. CENIC. Cienc. Quím., 32, 2, (2001), 69.

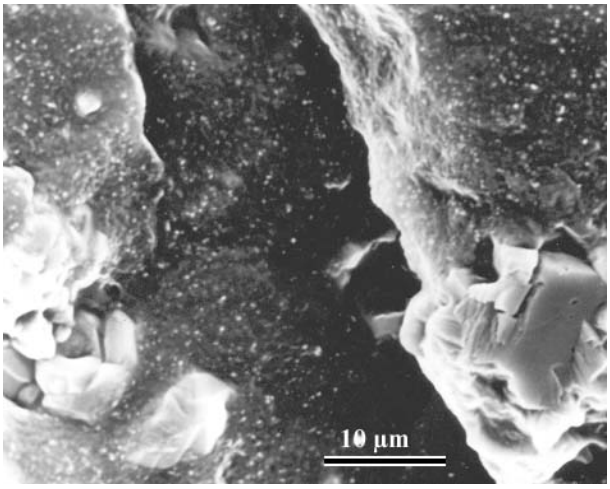

Fig. 1: Smoother and more regular surface and more crystalline aspect of Cuban carbonate particles in a natural Brazilian rubber matrix.

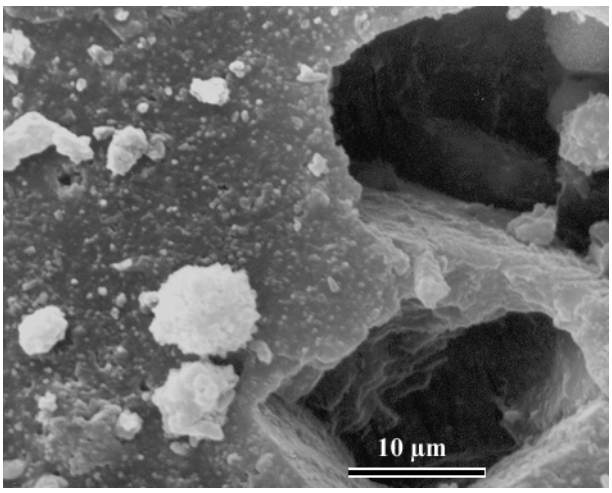

Fig. 2: Regular shape and more irregular surface of Brazilian carbonate particles in an styrene-butadiene matrix.

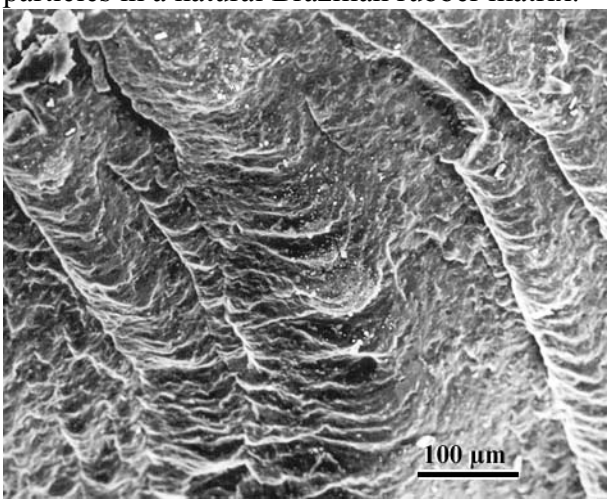

Fig. 3: More striated face of rupture of natural. rubber. Brazilian carbonate particles are covered by the matrix.

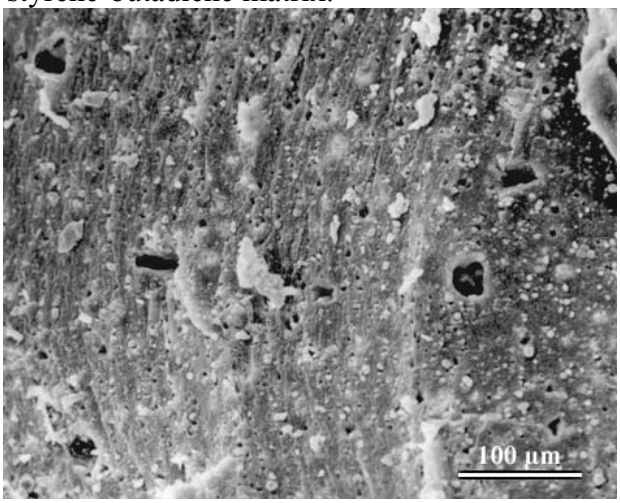

Fig.4: More flat face of rupture of synthetic rubber showing holes free of particles of Brazilian carbonate.

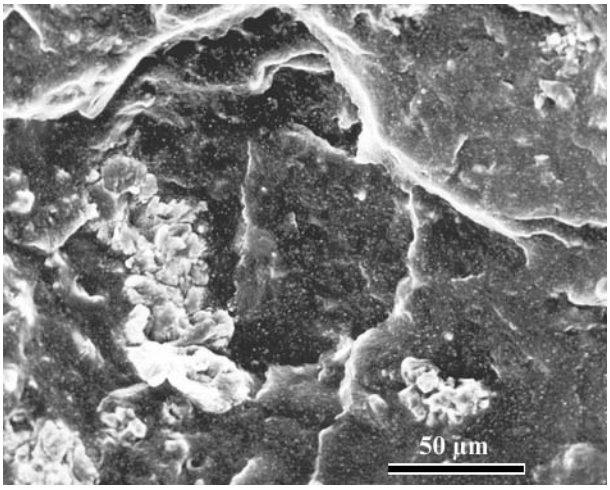

Fig. 5: Aggregations of Cuban carbonates particles in a natural rubber matrix.

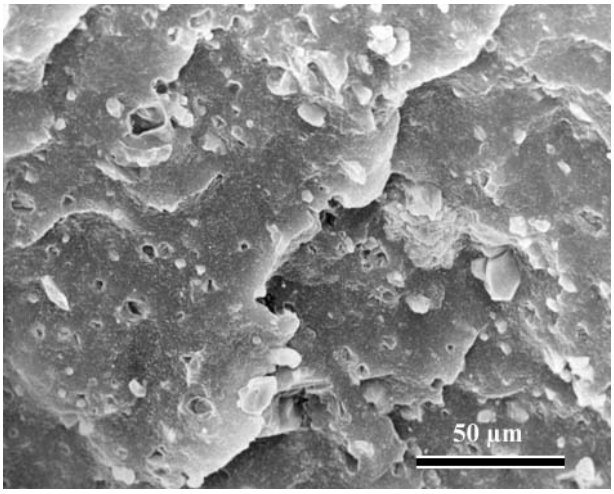

Fig. 6: More homogeneal distribution of Cuban carbonate in a synthetic rubber matrix.

https://doi.org/10.1017/S1431927603442281 Published online by Cambridge University Press