MINING AND METALLURGY INSTITUTE BOR
TEHNICAL FACULTY BOR, UNIVERSITY OF BELGRADE

47th International October Conference on Mining and Metallurgy

PROCEEDINGS

Editors:

Ana Kostov
Milenko Ljubojev

4th – 6th October 2015
Hotel "Jezero" Bor Lake, Serbia

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INFLUENCE OF HIDROPHOBIZED LIMESTONE AS FILLER ON THE MECHANICAL PROPERTIES OF PVC

Slavica Mihajlović, Dragan Radulović, Živko Sekulić, Vladimir Jovanović, Vladan Kašić

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ABSTRACT

The results have shown that the break force in the "wet" process increases with 1.51kN for PVC + C at 1.63kN, in a sample of PVC + CS-3, which is a completely hydrophobized. In the "dry" process, the breaking force increases from 1.51kN in PVC + C to 1.55kN in PVC + CD-3. Breaking limit increases with degree of hydrophobization and in the "wet" process from 36.72MPa in PVC + C to 38.17MPa in PVC + CS-1.5 and further to 39.89 MPa in a sample of PVC + CS -3. In the "dry" process, the breaking limit grows from 36.72MPa for PVC + to 38.26MPa in a sample of PVC + CD-3 with coating degree of 99.90%. Strength limit also changes with coating degree (hydrophobization), while the strength force remains almost unchanged in both procedures.

Keywords: *limestone, polyvinylchloride, hydrophobization*

1 INTRODUCTION

The limiting factor in the application of limestone in certain industries (such as filler in the industry of polyvinylchloride, PVC) is its hydrophilic surface. By procedures of surface modification of calcite as the main mineral in limestone, organic modifiers by the type of surfactants, it is possible to transform the hydrophilic surface in a hydrophobic. In this way, the limestone itself receives particularly hydrophobic properties [1, 2]. As a measure of the achieved surface hydrophobicity of calcite, the degree of coating is taken, present in the papers of the group of authors [3, 4, 5]. Applying the hydrophobized limestone as filler in PVC mixtures, the definitive products are obtained with better mechanical properties compared to the mechanical properties when the pure limestone is used.

2 EXPERIMENTAL PART

2.1 Material and methods

A sample of limestone was used for experimental research in this paper with the given physical-chemical and mineralogical characteristics in the earlier work and also the procedure for determining the mechanical properties [6, 7]. Composition of PVC mixture is the following: PVC = 4176.00 g; filler = 372.00 g; stabilizer = 141.00 g; lubricant = 11.00 g. The bulking agent is limestone which is hydrophobized by the "wet" method wherein the lining of complete (hydrophobization) is obtained in concentration of stearic acid of 1.5% and by the "dry" method, where the complete lining of the resulting stearic acid in concentration of 3% [7].

3 RESULTS AND DISCUSSION

The obtained values of strength and breaking limit and force of strength and breaking of PVC mixtures are shown in Table 1 (tags in Table: C-calcite, S-"wet" procedure, D-"dry" procedure, the number-concentration of stearic acid in the process of hydrophobization of calcite). Dependence of investigated mechanical properties of stearic acid share in the hydrophobization process is graphically shown in Figures 1 and 2.

Table 1 *The mechanical properties of PVC mixture*

Mechanical properties	Samples				
	PVC+C	PVC+CD-1.5	PVC+CS-1.5	PVC+CD-3	PVC+CS-3
Strength limit, MPa	52.75	52.67	54.21	53.69	52.41
Breaking limit, MPa	36.72	36.17	38.17	38.26	39.89
Strength force, kN	2.17	2.17	2.16	2.19	2.19
Breaking force, kN	1.51	1.49	1.52	1.55	1.63

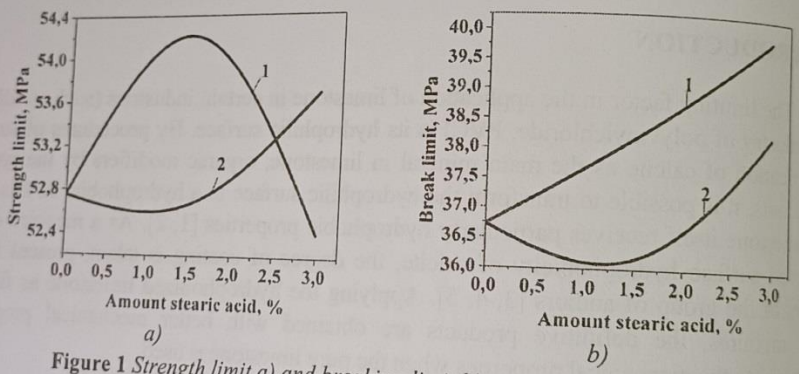

Figure 1 *Strength limit a) and breaking limit b) samples of PVC mixture: 1-calcite modification "wet" method, 2-calcit modification "dry" method*

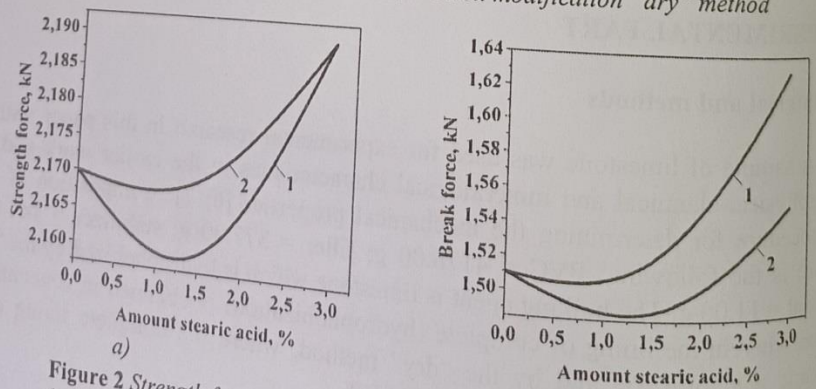

Figure 2 *Strength force a) and breaking force b) samples of PVC mixture: 1-calcite modification „wet" method, 2-calcite modification „dry" method*

Strength limit. Strength limit of PVC mixture shows the value of minimum stress uring stress that causes significant stretching of tubes without increasing the force [8, 9]. In e "wet" process of modifying calcite, the greatest value of strength limit of PVC mixture is 4.21MPa in the sample PVC + CS-1.5, which has coating degree of 99.90% (Figure 1a). A orrelation between the mechanical properties of PVC mixture and achieved degree of oating is also proven at this time. With the achievement of a complete overlay of pure alcite stearic acid, the fluidity of PVC mixture increase, thus its flexibility, which has the sult in moving the strength limit to higher value [10]. With increasing the content of stearic id in the process of modifying calcite on 3%, a sample PVC + CS-3, the value of strength mit of PVC mixture is reduced to 52.41MPa, regardless the value of coating degree was 9.90%. This is explained by the fact that the excess of stearic acid leads to consolidation of alcite particles by being adsorbed onto the surface thereof in the form of a bilayer. Larger rticles lead to a weakening the structure of PVC mixture, and due to this the value of rength limit is reduced [10]. In the "dry" process of modifying calcite, the greatest value of rength limit of PVC mixture from 53.69MPa is achieved to the sample of PVC + CD-3, hich has the highest coating degree of 99.90%. In this case, also a direct correlation etween the degree of achieved coating and strength limit is confirmed. With increasing the oating degree, obtained with optimal content of stearic acid, growing the value of strength mit in PVC mixture.

Breaking limit. The breaking limit values of PVC mixture (Figure 1b) in the "wet" rocess of modifying calcite by stearic acid increases from 36.72MPa in a sample of PVC + to 38.17MPa in a sample of PVC + CS-1.5. Increasing the value of breaking limit occurs ue to an increase in coating degree. Coating degree of 99.90% was achieved just to a sample f PVC + CS-1.5. By further increasing the content of stearic acid in the modifying process f calcite to 3%, a sample of PVC + CS-3 continues to increase the breaking limit value of earing 39.89MPa, regardless the fact that coating degree is not changed and it is 99.90%. In e "dry" process of modifying the calcite stearic acid, the breaking limit values grows from 6.72MPa in a sample ofsample PVC + C to 38.26MPa in a sample of PVC + CD-3, which as the highest coating degree of 99.90%. By this way, a direct correlation between the echanical properties of PVC mixture from coating degree was once again confirmed.

Strength force. During testing the tensile properties of PVC mixture, the force is easured, that acting on the tube leads to its linear expansion. In the "wet" process of calcite odifying by stearic acid, the strength force values of PVC mixture is approximate for all amples regardless the coating degree (Figure 2a). Coating degree has no influence on the rength force of PVC mixture, confirmed the studies in the "dry" process of calcite odifying. The strength force values are slightly changed and ranged from 2.16 to 2.19 kN.

Breaking force. Measuring the breaking force value which leads to the rupture of test be in the "wet" process of calcite modifying, it was fortified that its value grows from .51kN, in a sample of PVC + C to 1.63kN in a sample of PVC + CS-3 which has coating egree of 99.90% (Figure 2b). In the "dry" process of calcite modifying, the value of reaking force tearing of PVC mixture increases with 1.51kN in a sample of PVC + C to .55kN, in a sample of PVC + CD-3, which has coating degree of 99.90%. The increase the oating degree value, the samples are accompanied by the increased breaking force value.

4 CONCLUSION

The test results of mechanical properties showed that the mechanical properties of PVC mixture depends on whether the mixture contains clean or hydrophobized calcite, and which degree of hydrophobicity (coating) of calcite was reached. It is concluded that the mechanical properties are better when the mixture is of fully hydrophobized calcite, and then, the coating degree is 99.90%. Also, it was observed that the mechanical properties depend on whether a complete hydrophobicity of calcite is obtained using the "dry" or "wet" method. Based on the results, it could be concluded that the mechanical properties are better in PVC mixture containing calcite modified by the "wet" method.

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