Mortars prepared with mechanochemically treated asbestos-containing waste

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Introduction

Asbestos cement materials have a doubtful reputation all around the world. Even countries with a long history of production and successful use have a ban on all asbestos materials. However, regardless to the country the problem of efficient recycling of asbestos-containing waste (ACW) is still exist. ACW contains about 80…85 wt.% of cement and 15…20 wt.% of asbestos fibers. Given a major amount of cement in asbestos cement materials, it is possible to suggest that ACW contains some amount of non-hydrated minerals, and therefore has potential hydraulic activity.

The current research presents experimental results of mechanochemical treatment of ACW. In this purpose, ACW was milled in dry state with various amount of PNS superplasticizer. Using milled ACW the blended mortars were prepared.

Material and Methods

ACW samples were taken from the chrysotile cement plant “Kombinat Kransny Stroitel” in Voskresensk, Moscow region.

Analytical methods: SEM, EDS. XRD analysis was performed by Thermo ARL X’TRA High. Particle size distribution was investigated by FRITSCH Laser particle sizer Analysette 22. Specific surface of the samples was measured in accordance to the conventional Blaine method.

Cement was CEM I 42.5 N. PNS was commercially available sodium polynaphthalene sulfonate.

ACW was milled in a vibratory ball mill in the presence of PNS with dosage 7 % w.t. ACW substitutes 5; 10; 15 and 20 % w.t. of cement in the blended binder.

Strength was tested in accordance with GOST 310.4-81*. Cement. Methods of bending and compression strength determination. All samples were prepared with the same workability measuring by the slump cone.

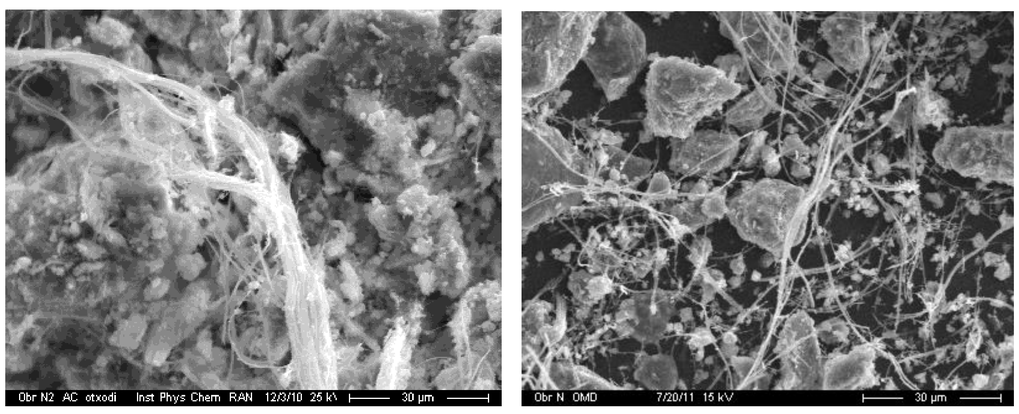

Fig. 1. SEM micrograph of asbestos-containing waste. Before and after the milling with PNS.

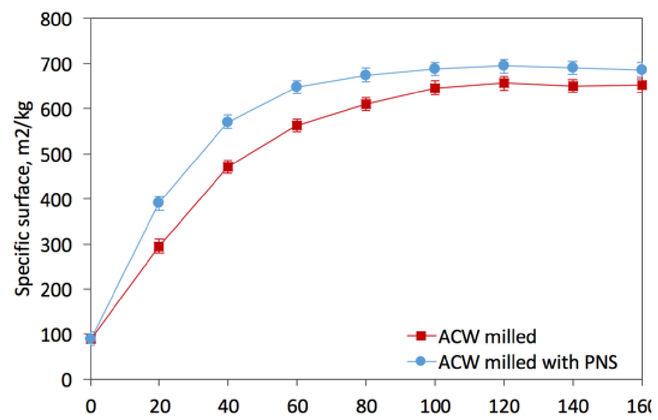

Fig. 2. Dependence of specific surface on milling time.

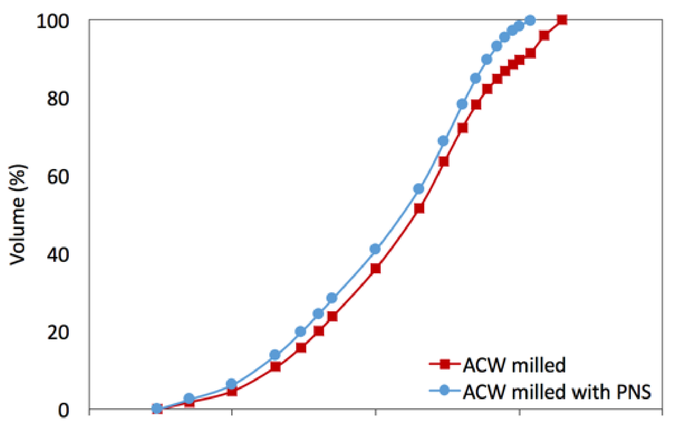

Fig. 3. Particle size distribution of milled ACW and ACW milled with PNS.

Results

Table 1. Strength of the blended mortars.

#	Composition	Flexural strength, MPa	Compressive strength, MPa
1	Reference		
	Reference	5.1	39.6
2	Mortar prepared with milled ACW, PNS is not introduced		
	10 ACW	4.4	30.8
3	Mortar prepared with milled ACW, PNS is introduced with water		
	10 ACW + PNS	4.8	33.8
4	Mortars prepared with ACW milled with PNS		
	10 (ACW + PNS)	5.8	48.9
	15 (ACW + PNS)	5.2	44.5
	20 (ACW + PNS)	4.9	37.3

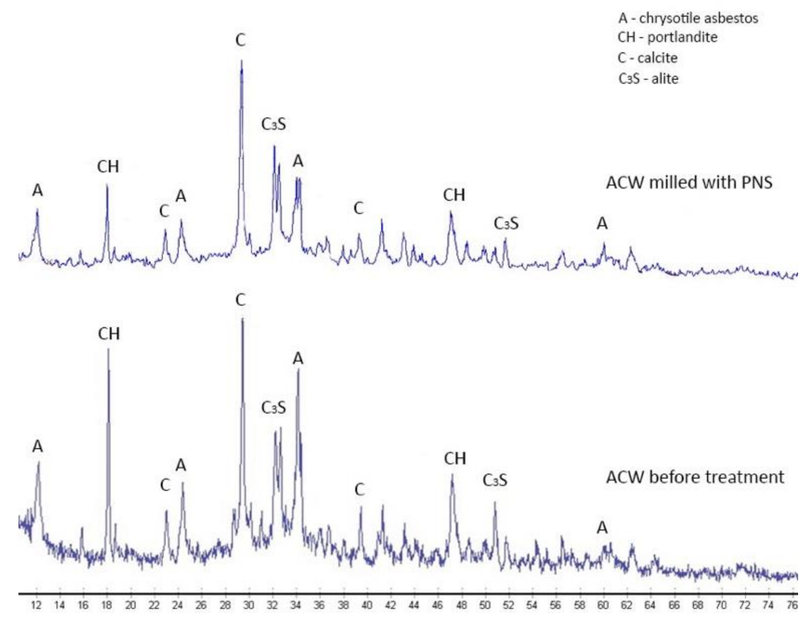

Fig. 4. XRD of ACW before treatment and ACW milled with PNS.

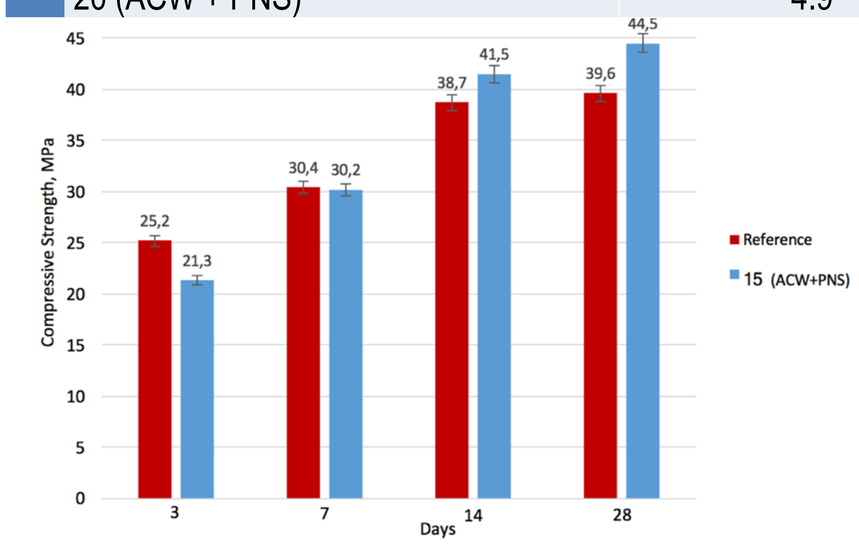

Fig. 5. Strength development of the blended mortars: 15 (ACW+PNS) and Reference.

Discussions & Conclusions

The current research presents the results of ACW recycling using mechanochemical activation. It is shown that ACW comprises partly hydrated C_3S that can be reactivated by means of mechanochemical treatment in a vibratory ball mill. Activation of ACW in presence of surfactant affects the milling process: the specific surface of powder in presence of PNS grows faster than milling of ACW apart of it. Compressive strength of the mortars prepared with mechanochemically activated ACW is increased by more than 20% with 10% wt. of cement replacement. The maximum substitution of cement to activated ACW is 15% wt. without loss of strength. The obtained results show that ACW could be successfully recycled as a replacement of the part of the cement in the blended binders.

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