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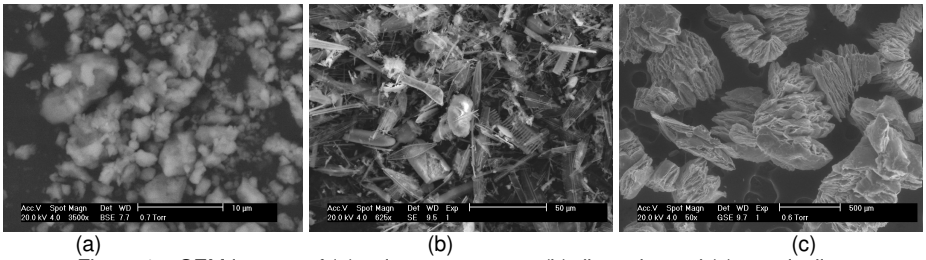
Light grout compositions containing calcareous quarry and clay minerals for oilwell cementing

Autores: Santos, M. L. L. O.[(1)]; Gouveia, P. S.[(2)]; Martinelli, A. E.[(2)]; Melo, D. M. A.[(2)]; Melo, M. A. F.[(2)]; Alves, K.[(2)]
[1, 2] Institution: UFRN – Materials Science and Engineering Graduate Program
mluizalopes@terra.com.br; aemart@uol.com.br

Abstract: Cement manufacturers are responsible for 5% of the worldwide CO_2 emission. To reduce such environmental impact, cementing composite materials can be prepared partially replacing Portland cement by calcareous quarry and clay minerals. The resulting composites must be characterized to determine key properties for structural materials including density, rheological parameters and compressive strength, in addition to chemical composition and microstructure. The results confirmed that cement can be replaced by mineral residues and clay minerals, resulting in adequate materials for onshore oilwell cementing operations.

Portland cement is the basic raw material used both by the construction companies and oil industry for structural applications. In the latter case, cement sheaths are used to grant mechanical stability to oilwells as well as to provide zonal isolation between neighboring rock formations. However, the production of 1 ton of Portland clinker releases the same mass of CO_2 to the atmosphere. Overall, 5% of the global CO_2 emission is produced by the cement companies [1]. To reduce the consumption of cement, and therefore the emission of CO_2, alternative cementing compositions that depict both sustainability and reliability have been proposed using cost effective and environmentally friendly materials, including residues [2]. The use of calcareous quarry (CQ) produced by rock comminution and clay minerals, including diatomite and vermiculite, are alternatives to partially replace cement in mortars for construction companies as well as grouts for oilwell cementing. In the present study, special attention was dedicated to the formulation and characterization of grouts for onshore oilwell cementing. The production of oil and gas in onshore fields is an important economical activity in Northeastern Brazil. Grout compositions containing calcareous quarry, vermiculite and diatomite partially replacing Portland cement were mixed, hardened and characterized by physical, rheological, and mechanical tests. The behavior of these materials was compared to that of a reference grout composition. The chemical and crystallographic compositions as well as particle size distributions of the starting powders were previously evaluated. The results indicated that it is possible to optimize the concentration of calcareous quarry and clay mineral addition to produced grout compositions that fulfill the requirements for oilwell cementing. The effect of underground pressure and temperature were also evaluated. The behavior of the alternative compositions was adequate to the service conditions encountered in onshore fields. These materials are promising alternatives to large scale use of cementing materials by the oil industry.



(a) (b) (c)

Figure 1 – SEM images of (a) calcareous quarry, (b) diatomite and (c) vermiculite.

Table 1: XRF oxide-equivalent composition of mineral admixtures.

		wt.%			wt.%			wt.%
CQ	CaO	77.568	Diatomite	SiO_2	84.609	Vermiculite	SiO_2	38.410
	SiO_2	11.866		Al_2O_3	11.015		MgO	19.844
	Al_2O_3	5.261		SiO_3	2.481		Fe_2O_3	18.470
	Fe_2O_3	2.231		Fe_2O_3	1.413		Al_2O_3	13.221
	Bal.	3.073		Bal.	0.481		Bal.	10.055

References:

[1] CAPELLO, G. **Cimento ecológico – produto tem nível de CO_2 reduzido em sua fórmula, causando menos impactos no meio ambiente**. Disponível em: http://planetasustentavel.abril.uol.com.br/inc/pop_print.html. Acesso em: 20 jun. 2008.

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