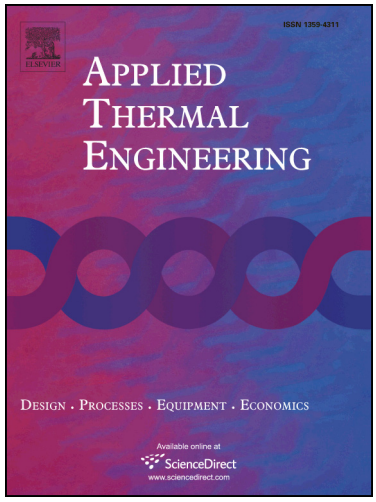

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The performance analysis of a new thermal backfill material for underground power cable system

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Abstract: Lafarge Gruntar™ material is proposed in this paper as a new thermal backfill component, and different mass fractions such as 5%, 10%, and 15% are examined. The thermal properties of the developed backfill are determined by experiments with respect to water content and time. Based on the experimental data it is found that the 15% mass fraction Lafarge Gruntar*TM* material provides the most favorable thermal conductivity i.e. over 1.00 W/(m K) in the dry state. This paper also presents a thermal performance optimization procedure for the high voltage underground power cable system. The new thermal backfill material is considered to be installed within the cable system to improve its thermal performance. The analyzed system consists of three underground power cables situated in a flat formation (in−line arrangement) in thermal backfill, buried in the native soil. To avoid extensive mechanical loads caused by vibrations, when locating beneath a paved ground (e.g. under road crossings), the cables are situated in High Density Polyethylene (HDPE) casing pipes filled with sand−bentonite mixture. The pipes are then placed into a thermal backfill and buried in the native soil. The Installation of thermal backfill material is relatively expensive since in many cases the buried line is installed over many kilometers. Therefore, it is important to determine the optimal dimensions of the cable bedding layer to minimize the material and installation costs while keeping efficient heat dissipation from the cables. The momentum-type Particle Swarm Optimization (PSO) solver, with a dynamic penalty function, is used to minimize the cable backfill cross-sectional area while not exceeding the allowable temperature of the cable operation. The performed optimization procedure obtains the converged solution. The temperature distribution in soil, cables, and the cable backfill layer is