EGU21-5654
https://doi.org/10.5194/egusphere-egu21-5654
EGU General Assembly 2021

Investigation of Fluidized Backfill Materials for Optimized Bedding of Buried Power Cables

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The transition towards renewable energy systems leads to increased loads on the electrical power grid. As a result, many transmission lines have to be extended or newly built. According to a government resolution, in Germany the preferred implementation of new high-voltage, direct current (HVDC) electric power transmission systems should be buried power cables.

When operating buried power cables, the mechanical and thermal properties of the cable bedding need to meet certain requirements. On the one hand, accurate positioning and protection of the cable and protection pipe from mechanical stress demand mechanical stability. On the other hand, electric losses during transmission result in thermal energy that needs to be dissipated. Since the ampacity of the cable depends on the maximum permissible temperature of the conductor, the potential load of the power line is directly connected to the thermal properties of the bedding.

To ensure both of these technical requirements, the pre-existing soil mostly is disposed and replaced by sand or artificial fluidized backfill materials with well-known material properties, resulting in potentially high logistical effort, environmental impact and costs. One way to address these effects could be the reuse of the excavated soils as a basic material for the on-site production of a fluidized backfill material, allowing for the adjustment of soil properties (within limits) by adding cement and other additives. By enhancing the thermal properties of the cable bedding, the ampacity of the cable route can be increased, potentially reducing land use due to smaller dimensions of the cable trench. Reusing excavated soils further reduces potential land use, since less material needs to be disposed in landfill sites.

Within the scope of our research, the technical and economical possibilities and limits of reusing excavated soils for the production of fluidized backfill materials are explored. In addition, the stability of fluidized backfill materials under cyclic load scenarios is investigated to assess possible alterations of such materials during cable operation, which may affect the long-term efficiency of the transmission system.