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Discussion: Effect of Bentonite Slurry Pressure on Interface Friction of Pipe Jacking

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Discussion of "Effect of Bentonite Slurry Pressure on Interface Friction of Pipe Jacking" by Mucahit Namli and Erol Guler

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The authors have presented a very interesting account of a series of novel laboratory tests carried out with the aim of investigating the resistance between a concrete jacking pipe and sand, including the effects of applying a lubricant to the interface. The authors achieved very good agreement between laboratory testing and field results. The field results came from a project carried out under very conveniently similar conditions on site as in the laboratory (a site characterized by dense sand, and where three different lubrication application regimes were employed that matched the lubricant application regimes used during the laboratory testing). However, no information was provided about the grading of the sand at the site or its angle of internal friction. The authors report that "approximately a 90% reduction in the interface coefficient of friction can be achieved" and that "applying bentonite with minimal injection pressure is enough."

The discussers write to compare the authors' results with a series of laboratory tests carried out using a different testing apparatus but with the same aim (Reilly and Orr 2017). The discussers used a modified triaxial testing apparatus adapted so that the shearing resistance on the interface between a sand specimen and a concrete specimen of similar surface roughness to a jacking pipe could be measured. The apparatus allowed lubricant to be injected into the interface during shearing. The discussers' findings were that the lubricant slurry blocks the pores in the soil and, with the pores blocked, this allows the fluid pressure within the slurry to be transferred to the soil skeleton, thus reducing the radial effective stress acting on the pipe barrel. Hence the discussers concluded that the main beneficial effect of lubricant injection is to reduce the effective stress locally in the interface.

While the discussers' finding that pressurization of the lubricant applied in the interface between the sand and the jacking pipes at least equal to the hydrostatic pressure is required to bring about the reductions in the magnitude of shearing resistance observed during field studies (i.e., greater than 90%) agrees with the authors' finding, the mechanism of action that the discussers have deduced is different from the authors' and they would be interested in the authors' views on this.

While the discussers have also shown from their test results that injection of a lubricant can bring about reductions in the frictional resistance force of the order of 90%, they did not find evidence that the presence of bentonite, at the volumes commonly introduced during pipe jacking, alters the physical character of the interface, i.e., changes the angle of interface friction, δ, or the coefficient of friction, μ_{int}, between the soil and the pipe to any significant degree, and hence concluded that it does not cause lubrication but rather that it causes a reduction in the effective normal stress instead. The discussers wonder if the authors considered the effective stress conditions at the pipe–soil interface in their tests before concluding that the skin friction reductions observed in their tests were due to a reduction in the coefficient of friction between the pipe and soil through the replacement on the interface of sand by bentonite with a lower coefficient of friction, and if they have any findings that might provide further information with regard to this.

References

Reilly, C. C., and T. L. L. Orr. 2017. "Physical modelling of the effect of lubricants in pipe jacking." *Tunnelling Underground Space Technol.* 63: 44–53. https://doi.org/10.1016/j.tust.2016.11.005.