
Contribution ID: **507**

Type: **Poster + 3 Minute Pitch**

# A groundwater flow model : Flow behavior through anisotropic granular porous media

*Thursday, 17 May 2018 11:59 (2 minutes)*

The flow behavior through porous media is yet to be fully understood. The comprehension of the fundamental physical mechanisms and of the dynamics can significantly help the development of many applications in the engineering field.
A porous system can be formed by natural as well as by artificial processes, and is mostly described by granular media, compacted under external forces. The pore size and pore size variation are strongly dependent on the grain topology and size distribution. Most of the naturally formed porous media exhibit an anisotropic behavior, an example of which are soil formations created by sedimentation processes over long periods of time.
In the case of groundwater remediation, the flow is superimposed by a forced convection, which is induced by recirculation wells with integrated pumps. The main idea of groundwater recirculation is to enforce vertical flow paths through the ground, and to increase the radius of influence of the remediation proces, which is determined by the soil resistance against the flow. The permeability and conductivity of the soil layers dictate the flow behavior in various directions. The knowledge of this operating range and of the correlations between influencing quantities, is essential for the layout of groundwater remediation technologies.

For an accurate description of the flow behavior through soil layers, several geometric parameters which characterize the anisotropic nature of the granular media, must be considered. Therefore, the generation of a realistic 3D topology of the soil formation is fundamental. Within this work, an extensive characterization of the shape complexity, the surface roughness, and the size distribution of granular structures in natural soil formations, is performed. Furthermore, a study of the dense nature of the grain packings is conducted. The results are used to generate realistic soil models, constituted by 3D granular structures with defined size distributions, by specialized filling algorithms.
Digital models, based on experimental data, are used to set up a flow model for simulation studies. The main objective is to determine the anisotropic flow resistance as a 3D tensor, which can be used as an input parameter for the construction of macroscopic groundwater flow models, with much less computational effort. Furthermore, the simulation studies provide relevant information concerning contaminant mobilization, the effect of forced convection, and the radius of influence under different operation conditions and soil compositions. An additional benefit of the computational studies is the possibility to characterize not only natural soil formations but also almost any entangled granular porous media by their hydraulic properties.

Being able to obtain a 3D hydraulic conductivity tensor from realistic underground soil structure topologies is a big step forward towards the understanding of underground water flow.

## References

## Acceptance of Terms and Conditions

Click here to agree

**Primary author:** Mr ABAD GONZALEZ , Andres (Karlsruhe University of Applied Sciences - Institute of Digital Materials Science)

**Co-authors:** Mr VELUVALI, Pavan (Karlsruhe University of Applied Sciences - Institute of Digital Materials Science); Dr KNEER, Aron (Karlsruhe University of Applied Sciences - Institute of Digital Materials Science); Mr REITER, Andreas (Karlsruhe University of Applied Sciences -Institute of Digital Materials Science ); Prof. NESTLER, Britta (Karlsruhe Institute of Technology - Institute of Applied Materials); Dr SELZER, Michael (Karlsruhe University of Applied Sciences - Institute of Digital Materials Science); Mr ALTSCHUH, Patrick (Karlsruhe Institute of Technology - Institute of Applied Materials)

**Presenter:** Mr ABAD GONZALEZ , Andres (Karlsruhe University of Applied Sciences - Institute of Digital Materials Science)

**Session Classification:** Parallel 10-E

**Track Classification:** GS 4: Porous media applications (renamed)