**Grain reconstruction of porous media: Application to a Bentheim sandstone**

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The reconstruction of a porous medium from given data can be done in several ways and this contribution analyzes and illustrates some of its aspects.

The first technique which was used was the two-point correlation of the phase function which can be measured on a two dimensional thin section. The reconstructed porous medium is generated by means of suitably correlated and truncated Gaussian fields which have the same statistical correlation properties as the measured ones. However, the permeability and the formation factor of such reconstructed porous media are not in close agreement with the properties calculated on the real sample. Hence, there was and still is a need to develop techniques which are adequate to generate realistic media.

The second technique of generating porous media consists in a Poissonian generation of polydisperse spheres, also called grain reconstruction. The probability density of the sphere radii can be derived from the probability density of the covering radius which necessitates to know the three dimensional geometry of the porous medium. Such information can nowadays be obtained by Computer MicroTomography. Various geometric and transport properties are determined on the experimental and reconstructed samples. The most important success of the present reconstruction technique is the fact that the numerical sample percolates despite its low porosity. Moreover, the geometry, the permeability and the conductivity are in good agreement with the measured properties.

The second technique is made complicated by the necessary knowledge of the three dimensional geometry of the real material in order to obtain the probability density of the covering radius. However, it was realized that the two-point correlation measured on a thin section can be used to derive the probability density of the radii of a population of penetrable spheres.

The geometrical, transport, and deformation properties of samples derived by this third method compare well with the properties of the digitized real sample and of the samples generated by the standard grain reconstruction method.

Therefore, the grain reconstruction can be used directly from a two dimensional measurement. Moreover, it is interesting to see that the same correlation function can be used to derive media either by truncated Gaussians or by Poissonian spheres with very different resulting geometries and properties.