5. CONCLUSIONS

Particle transport for different flow patterns and boundary conditions undergoing shearing processes is studied. The results provide a first step towards a better understanding of particle transport in coupled stress-flow processes. The main conclusions, which are divided into two main issues, shear-induced flow anisotropy and particle transport, are summarized as follows.

1) Shear-induced flow anisotropy:

- A channelling effect is generated perpendicular to the translational shear direction, which provokes a shear-induced anisotropy in the aperture and transmissivity distributions.
- Aperture and transmissivity values become much less correlated under translational shear than under rotary shear, especially in the direction parallel with shear direction, and the correlation length of the fracture changes during translational shear.
- Rotary shear induces an isotropic transmissivity field with high correlation in all directions.

2) Particle transport:

- Shearing processes make rough fractures much more permeable, producing a significant decrease in travel time of the particles, especially at the start of the shear processes.
- Translational shear yields a channelling effect perpendicular to the shear direction, creating high transmissivity channels through which particles travelling in this direction can go fast and without being delayed by bypassing low transmissivity areas, as it happens when fluid flows parallel with shear direction.
- Particles have a smaller mean value and standard deviation for travel time and tortuosity in the case of flow perpendicular to the shear direction, due to the channelling effect.
- Bi-directional flow patterns show clearly the shortcomings of the conventional shear-flow tests in the laboratory with a unidirectional flow, as indicated by the fact that fluid flow and particle transport are dominant in the direction perpendicular to the shear direction.
- For the radial flow under translational shear, shear induces a shift in the transport dominating directions, from the direction parallel with the shear direction to the direction perpendicular to the shear direction, due to the channelling effect.
- Radial flow becomes rapidly isotropic with rotation and particle transport is much homogeneous than in the case of translational shear. The travel time is greatly reduced at the start of the rotary shear due to an almost uniform dilation over the whole sample area.
- In radial flow patterns, while translational shear has an anisotropic particle transport behaviour with faster transport perpendicular to the shear direction, rotary shear presents isotropic flow field and particle paths in all directions.