

## **Influence of extrusion conditions on the rheological behavior of nuclear bituminized waste products (BWP)**

*MOUAZEN Mouhamad, POULESQUEN Arnaud, VERGNES Bruno*

In France, most of the radioactive wastes from low to medium activity and long life coming from chemical treatment of liquid effluents are encapsulated with bitumen by extrusion. The nuclear BWP is composed by approximately 40 wt % of salts and 60 wt % of bitumen. These incorporated salts are of two types: soluble or insoluble. In this study, we have characterized the influence of processing conditions (screw speed  $N$  and feed rate  $Q$ ) on the dispersion state of salts, their morphology and the particle size distribution. For security and safety reasons, models samples have been prepared on a laboratory co-rotating twin screw extruder to be the most representative of the industrial samples in term of final composition. Samples characterization with environmental scanning electronic microscopy (ESEM) shows some differences according to the type of salts (soluble or insoluble). In the case of  $\text{BaSO}_4$  monosalt (insoluble), a low  $Q/N$  ratio leads to a decrease of the number and the size of aggregates, accompanied by dispersion improvement. On the other hand, the increase of this ratio shows that the number of  $\text{BaSO}_4$  aggregates increases. For the soluble salts ( $\text{NaNO}_3$ ), the crystal size is smaller and a better dispersion is observed with a low  $Q/N$  ratio. The increase of this ratio leads to a bigger size and different morphologies of these crystals inside the bitumen matrix. We have observed the same phenomena in the study of salts blends ( $1/3 \text{ NaNO}_3$  and  $2/3 \text{ BaSO}_4$ ). A rheological study for these bitumen compounds has been finally performed in order to link the microstructure and the operating conditions.