Production of the mixture

The production strategy was designed on the dependency of the mixture dry density on the pellet dry density and the porosity between the pellets:

$$P_{\text{mixture}} = (1 - \varphi_{\text{inter-pel})} P_{\text{dry pellet}}$$

For the pellet dry density, a minimum value of 2 g/cm³ was required. Inter-pellet porosities cannot be set as a requirement and it was chosen to optimize the grain size distribution instead. The mixture was required to have a Fuller type distribution: the percentage of passing p (in weight) through a sieve of size d is

$$P = \frac{d^n}{D} - 100$$

where n, the shape parameter was required to be 0.4 and where D, the max grain size of the mixture was required to be in the range [5mm, 10mm]

Raw material

The water content and grain size distribution were required in a certain range (red lines and green lines in the left and right figure, respectively). The required water content is believed to be close to the Proctor optimum for the compaction energy used.

Production of pellets

The production was done in two steps (1 in 2013 and 1 in 2014) to minimize the risks during the production of the biggest batch. Pellet dry density requirement was overachieved in the 2 productions.

Production of the mixture

During the first production step (2013), several iterations had to be done to achieve the required result (left figure hereunder). The pouring dry density of the mixture was satisfactorily and allowed to achieve the target emplacement dry density in the FE.

Conclusions/lessons learnt

- During the mixing process the broadly distributed grain size distribution is obtained by grinding big particles into smaller. The produced lines have a smaller particle density. Optimizing this (e.g. by producing directly different fractions in the right amount and softly mix them) was found economically not viable.
- Higher D value (max grain size of the mixture) could potentially increase the mixture dry density even more.
- A broad grain size distribution results in a mixture with a high compaction potential.