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Appendix F

(by B. Cazaciu and M. Dauvergne – LCPC/DDGC)

The concrete of UHPFRC slabs to be used in the NR2C model has been manufactured in a twin-shaft concrete mixer with a capacity of 500 litres. However, when producing UHPFRC the mixer capacity is limited to about 300 litres. As a consequence, two batches are employed for the manufacture of one slab. Slab 1 one was produced with batches 4 and 5, slab 2 with batches 6 and 7, slab 3 with batches 8 and 9 and slab 4 with batches 10 and 11 (batches indicated in the Figure F-1).

The total water content of the batch is fixed to obtain an 800 mm slump flow of the produced UHPFRC. The total water content is first chosen after tests at a smaller scale in a 20-litres laboratory twin-shaft mixer. This first indication is subsequently verified and slightly corrected after one test at the manufacture scale in the central mixer plant.

The figure F.1 represents the mixing power evolution of the batches produced during current experiments. It may be observed the loading sequence:

- the sand and cement are loaded from 0 to 10 seconds of operation time;
- the silica fume is manually loaded at 30 seconds (the corresponding quantity is pre-weighed);
- begin of water introduction at 120 seconds (loading time of about 15 seconds);
- begin of superplasticizer loading at 300 seconds (loading time of about 5 seconds);
- begin of fibers loading at 600 seconds (loading time of about 5 seconds);
- emptying of mixer at 690 seconds of operation time.

The total mixing time is of 10.5 minutes with 2 minutes of dry mixing, 1.5 minutes of mixing with fibers and 3 minutes of delay between water and superplasticizer loading.

The batches 2, 4 and 8 are produced in a previously cleaned mixer. This disturbs the mixing power during the dry mixing but is not the sign of a different mixing behaviour for these batches. Indeed, for the other batches, the concrete already produced in the same mixer lubricates the shafts ball bearings and diminishes the power consumption. This effect progressively disappears after the superplasticizer loading and the power evolution with mixing time may be compared for all batches beginning with the fluidity time.

In the mixture state evolution during mixing, the fluidity point corresponds to the forming of a paste. The points detected during the present experiments are indicated in the Figure F-1 by black dots. Figure F-1 also represents fluidity points corresponding to previous batches producing UHPFRC with the same mixer at a same filling ratio. From a mixing behaviour point of view, it may be concluded that the mix-design is of the same nature as the previous UHPFRC tested.

Batches 2 and 3 are manufactured at a slightly larger filling ratio (310 litres comparing with 280 litres for the others batches). This may explain a slightly longer fluidity time as expected given the fluidity line (line fitting the fluidity points for a given process, loading sequence and filling ratio) indicated in

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figure F-1. Anyway, the concrete corresponding to batches 2 and 3 was not used for the preparation of a slab.

When considering the power curves corresponding to each of the 4 slabs (Figure F-2) it is observed that slabs 1 and 4 are practically identical from a concrete manufacture point of view. Slabs 2 and 3 are expected with a slightly smaller workability, and a slight heterogeneity between the two corresponding batches is possible for the slab 3. The water to fine elements ratio in the slabs 2 and 3 is probably about 0.005 lower then in the slabs 1 and 4.

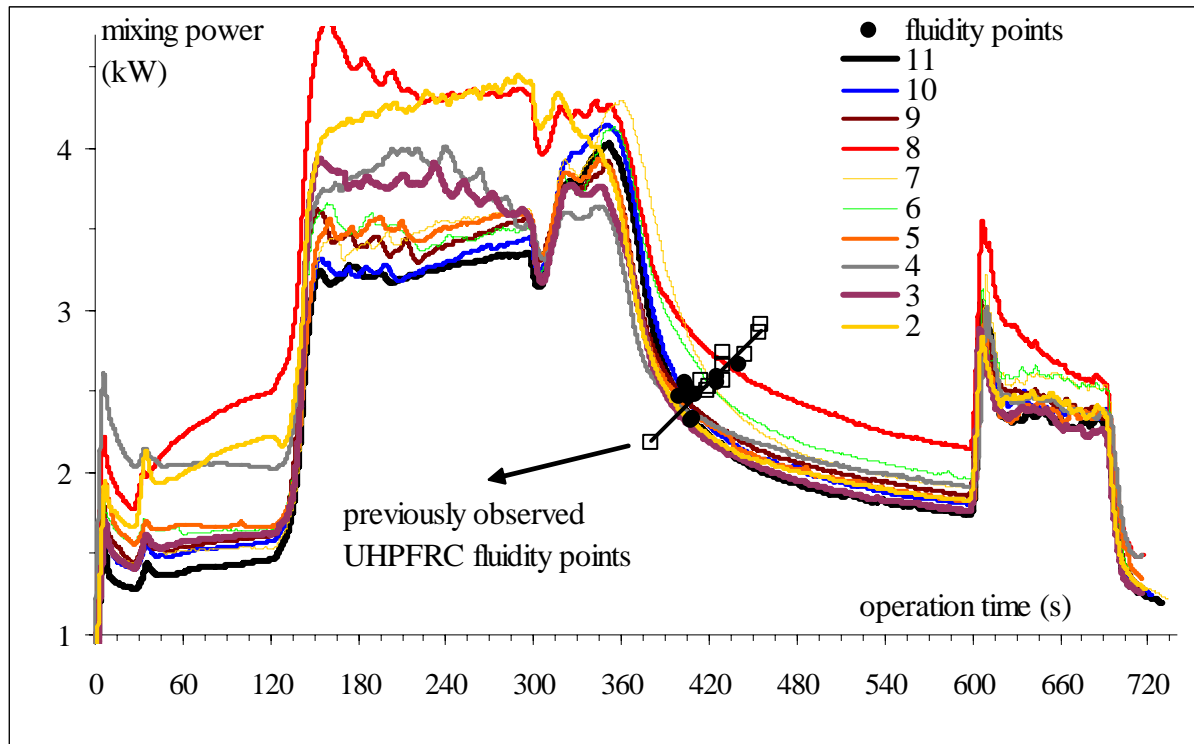


Figure F.1 - Mixing power evolution of the batches produced at a fixed mix-design, fluidity points for the given batches and the fluidity points observed for a previously tested commercial UHPFRC.

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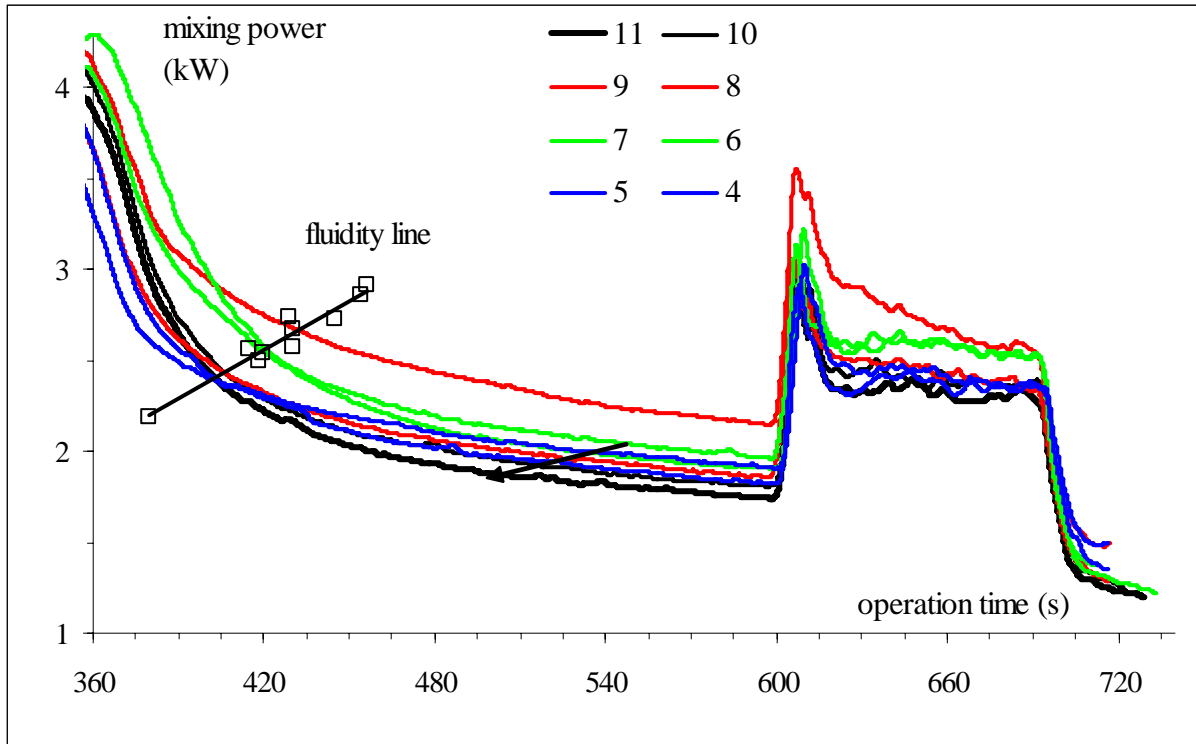


Figure F.2 - Mixing power evolution of the batches produced for the 4 slabs.

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