PLASTOMETRY FOR THE SELF-COMPACTING CONCRETE MIXES

VIDEVUDS ARIJS LAPSA[1], ANDREJS KRASNIKOVS[1], VITALIJS LUSIS[1], ARTURS LUKASENOKS[1,2]

[1]*Concrete Mechanics Laboratory, Faculty of Civil Engineering, Riga Technical University, Riga, Latvia*
[2]*Intitute of Mechanics, RTU Concrete Mechanics Laboratory, Riga Technical University, Riga, Latvia*
E-mail: andrejs.krasnikovs@rtu.lv

Traditionally, for prompt rheological consistence determination of self-compacting concrete mixes the Abram's cone, the Vebe's device, the U-box siphon as well as L-box or funnel tests are used. At the same time is worth mentioning that these field methods are determining some indirect mechanical characteristics of such very complicated paste-like material as concrete mix. These are the slump of the conical sample or the spread (diameter) of the diffluent concrete pancake, degree of the self-leveling in siphon, the time of the flow-out through the funnel or the Vebe time. All these parameters cannot be observed as direct mechanical parameters may be included into rheological equations describing fresh concrete as a non-linear liquid.

The main rheological parameter that differentiates the usual concrete mixes from the self-compacting mixes is the yield stress. Self-compacting concrete mixes are behaving liquid-like and in consistency equation they are characterized by yield stress.

For the yield stress measurement conical plastometer can be used [1]. Previously, this device and measuring methods were used for determining forsmall of paste-like materials (pastes and concretes). It can be used for liquid like materials, too. At the same time, for field tests, where the concrete volumes are greater and the observed self-compacting mixes can show liquid- like rheological behaviour, the well known method of calculation is not precise enough, because the conical indentor is small (15 cm) and the buoyancy force of the liquid mix also is not taken into consideration.

Taking into account the above mentioned obstacles a conical plastometer having higher precision and less sensitivity to the inaccuracy during tests in a field condition was elaborated in the Concrete Mechanics Laboratory of RTU. A new method was also elaborated for the yield stress calculation, taking into account the buoyancy of the liquid (or paste like) concrete mix [2]:

where $F\Sigma$ is the total axial force acting on the indentor;
$F\mathrm{Arch}$ is the buoyancy force;
h is the depth of the immersion of the indentor into concrete mix;
k is the coefficient depending of the angle α of the pointed end of the indentor;
ρc is the density of the concrete mix.

In such a way these rheological tests of the concrete mix by use of the proposed plastometer and the said methodic could give an answer to three questions:
Is the real mix self-compatible or not?
If yes, we can calculate the real value of the yield stress of the mix.
We can follow these measurements for further determination of the time of appearance and increase of the mix plasticity and for further investigation all kinetics of the early processes of the setting and formation of the new microstructure in the concrete mix, too.

[1] Valjamae G.H., Gordon V.I., etc., Tallinn Technical University, Conical plastometer. Patent of the former USSR Nr,748190, publ. June 15, 1980
[2] Lapsa V.A. , Krasnikovs A., Lusis V., Rheological testing process for paste-like materials, Latvian patent Nr.14530, publ. June 20, 2012