

ERMCO Technical Committee: Summary responses to Survey on the control of w/c ratio

Introduction.

Colleagues, we are trying to write a confidential state-of-the art report of how water/cement ratio is measured and controlled at readymix plants, both for conformity and for production control. We know that there are different types of plant with different levels of sophistication and automation, and that there are big differences between high-volume plants in big cities, and low-volume plants in remote locations. But, for all types of plant, we want to get a better understanding of how producers, in reality, actually do this in Europe. The questions we ask will be about the situation, generally, in your country, not just about big plants. We know that you probably don't have accurate information, but please do your best to give us a good guess or say, 'don't know'. Where relevant, please say if there is any difference between plants which are/are not certified by a third party.

Notes on answers:

1. except where indicated, Belgian answers refer only to the certified plants - 57% of the total.
2. UK reply based on response from two companies.

Organisation responding to the survey

Organisation:

Contact person:

E-mail address:

A. Questions related to batch records

1. What proportion of plants have computerised batching instructions (the weights to be batched)? Belgium 100%; Denmark 100%; Finland 95%; Israel 100%; Poland 80%; Sweden 100%; UK 100%.
2. What proportion of plants have automatic weighing i.e. without intervention of batcher? Belgium 100%; Denmark 100%; Finland 85%; Israel 100%; Poland 80%; Sweden 100%; UK 100%.
3. What proportion of batching instructions is calculated on the basis of dry mass? Belgium 100%; Denmark binders (cement + additions), fibres; Finland 100%; Israel 50%; Poland 70%; Sweden 0%; UK 0%.
4. What proportion of batching instructions is calculated on the basis of saturated surface dry mass? Belgium 0; Denmark all aggregates; Finland --; Israel 50%; Poland 20%; Sweden 100%; UK 100%.
5. Are the batch instructions (that is, the batch weights) usually controlled/changed from a central office, or on the plant itself? Belgium plant; Denmark plant ('batch reports'); Finland both; Israel central office; Poland central office; Sweden plant; UK central office.
6. What proportion of plants have autographic recording equipment? Belgium 100%; Denmark 100%; Finland guess 85%; Israel all; Poland 60%; Sweden 100%; UK 100%.
7. For plants with autographic recording equipment, how frequent are cases where the batch records shows non conformity with allowed tolerances, yet the physical appearance of the load is normal?

Belgium frequent in small loads and small quantities of admixture; **Denmark** 2 – 4x/week/plant;
Finland 1 - 5%; **Israel** infrequent; **Poland** 5%; **Sweden** very rare, 0,5 % or less; **UK** 5% of loads.

8. What, in your view, are the reasons for such non-conforming records?

Belgium tolerances impossible for small loads/quantities; **Denmark** small loads ; **Finland** use of out-of-date moisture contents; **Israel** weighing errors; **Poland** weighing equipment error; **Sweden** not relevant; **UK** cement overweigh on small loads, excess water, plant malfunctions or moisture content errors.

B. Questions related to cement and addition batching

9. How frequently is the weighing equipment checked? (and any difference between certified/non-certified plants?)

Belgium annually; **Denmark** annually; **Finland** annually; **Israel** once or twice annually; **Poland** internal check annually, third party check every two years; **Sweden** not relevant; **UK** three-monthly.

10. Do plants operate a stock control system: cement/addition into the plant – cement/addition out of the plant?

Belgium generally yes; **Denmark** yes; **Finland** yes; **Israel** yes; **Poland** yes; **Sweden** yes; **UK** yes.

11. For plants with autographic recording equipment, are the autographic records always accepted as being the best record of what was in the concrete?

Belgium yes; **Denmark** yes; **Finland** usually, except in cases of dispute, or very important contracts; **Israel** yes; **Poland** yes; **Sweden** **UK** yes.

12. For plants without autographic recording equipment, are records of the mass of cement/addition batched for each load recorded?

Belgium for non-certified plants, probably not; **Denmark** not relevant; **Finland** in principle, yes; **Israel** not relevant; **Poland** always; **Sweden** not relevant; **UK** not relevant.

13. For plants without autographic recording equipment, is the cement/addition content of each load assumed to be the target value or does the batcher accurately record what is *actually* batched?

Belgium for non-certified plants, probably no record; **Denmark** no such plants; **Finland** in principle, yes; in practice may be the target; **Israel** not relevant; **Poland** accurate record; **Sweden** not relevant; **UK** not relevant.

C. Questions related to the moisture control of the aggregates

<p>14. What proportion of plants have moisture probes fitted in the sand hoppers? Belgium few; Denmark 100%; Finland 5-6%; Israel 10 - 20%; Poland 70%; Sweden >50%, but not always used or calibrated; UK 50 – 100%.</p>
<p>15. What proportion of plants has computerized control of batching that automatically takes account of the moisture probe readings? Belgium less than few; Denmark 100%; Finland 3%; Israel 10%; Poland 70%; Sweden maybe 5%, otherwise used only as indicator of any change; UK 10 – 100%.</p>
<p>16. What is your opinion on the reliability of fitted moisture probes? And do you know the estimated accuracy of such probes? Belgium difficult to calibrate, and fragile; Denmark microwave and capacity: +/- 1.0 %. Radioactive probes: +/- 0,5 % for equal packing of aggregates in silo; Finland good reliability; Israel unreliable in past, now more reliable; Poland unreliable, accuracy only 50%; Sweden OK (+/- 0.5%) if properly calibrated; useful as a guide, but rarely used without strict verification procedures; newer types quite accurate; can be very reliable but problems with rapid changes in moisture content.</p>
<p>17. What proportion of plants have moisture probes in the coarse aggregate hoppers? Belgium very few; Denmark estimates: 8 mm grading - 20 %, ≥16 mm grading 5 %; Finland 1 - 2% Israel none; Poland 5%; Sweden none; UK 0%.</p>
<p>18. For plants without fitted moisture probes, how frequently are the sands checked for moisture content? Belgium at least daily; Denmark one per production day; Finland daily; Israel daily; Poland daily; Sweden in principle daily, but in practice probably less; UK at least daily.</p>
<p>19. For plants without fitted moisture probes, how frequently are the coarse aggregates checked for moisture content? Belgium at least daily; Denmark one per production day; Finland weekly; Israel daily in winter only; Poland monthly; Sweden rarely, once a week at best; UK monthly, or an assumed seasonal value.</p>
<p>20. For plants <u>without</u> fitted moisture probes, what methods are used to determine the moisture contents of the aggregates? For each method, can you estimate the percentage using that method? Belgium microwave or oven drying, plus, maybe, hand-held probes; Denmark microwave; Finland oven: 25%, microwave 70%, gas oven 5%; Israel usually oven-drying; Poland oven 90%, microwave 10%; Sweden UK microwave.</p>
<p>21. What types of hand held moisture probes are used? Do you know the estimated accuracy of such probes? Belgium no data; maybe electrical resistance; difficulty of calibration; Denmark not used; Finland accuracy 1%; Israel digital, poor accuracy; or 'Speedy', calcium carbide; Poland not used; Sweden not used; UK not used.</p>

D. Questions related to the plant and trucks

<p>22. What proportion of central mixers have torque meters? Belgium all (ampèremeters); Denmark all, amperemeters or oil pressure gauge; Finland 90%; Israel irrelevant; Poland 80%; Sweden all; UK 90 – 100%.</p>
<p>23. Over what range of consistence do you believe the torque meters to be reliable? Belgium low precision, but generally OK to identify consistence class; Denmark 40 – 220mm slump; Finland S1- S4, unreliable with high dose of plasticiser; Israel not relevant; Poland S1 – S4; Sweden accurate for S1 – S5 if properly calibrated; UK ± 30 mm up to 150 or 200 mm slump.</p>
<p>24. What proportion of the final water added during mixing water is controlled automatically by the torque meter? Belgium none; Denmark estimate 60%; Finland 10%; Israel not relevant; Poland none; Sweden in principle 10lt/m³; UK none – batcher control.</p>
<p>25. What proportion of the final water added during mixing water is controlled manually? Belgium none; Denmark estimate 40%; Finland 90%; Israel most of it; Poland 100%; Sweden some ... unable to give a figure; UK 100%.</p>
<p>26. What proportion of central mixers have moisture meters fitted to the mixer? Belgium none (precast only); Denmark none (precast only); Finland less than 1%; Israel not relevant; Poland 5%; Sweden none, bad experience with use; UK up to 5%.</p>
<p>27. What proportion of truckmixers have torque meters? Belgium all; Denmark none, and no water tanks on trucks; Finland zero – trucks not used for mixing, only agitating; Israel 90 – 100%; Poland 2%; Sweden none; UK 95%.</p>
<p>28. For truckmixers without torque meters, how is the consistence controlled, e.g. visually? by sound? Or some other way? Belgium non-certified producers – visually; Denmark on site, visual inspection only, unless producer test. ≥95 % of consistence testing is at plant. Finland not relevant; Israel visually; Poland visually, or by slump test; Sweden irrelevant – trucks not considered as ‘mixers’, just agitators; UK visually.</p>

E. Questions related to the measurement of w/c ratio in fresh concrete

<p>29. Is the measurement of the water content of fresh concrete part of national conformity requirements? Belgium yes; Denmark yes, in NAD; Finland no; but third party scheme requires w/c assessment weekly if no moisture probes; Israel yes; Poland no; Sweden daily assessment, but no measurement; UK no.</p>
<p>30. EN 206 requirement is a 'determination' once a day. How do most producers undertake this? What are the procedures? Please provide details of the frequency and method used. Belgium microwave, oven drying or on gas burner – all used; Denmark calculation every load from daily moisture content checks; Finland batch records; Israel generally by manual calculation, some automatically from batch computer; Poland rarely performed; Sweden from batch record; UK batch records.</p>
<p>31. Is the measurement of the water content of fresh concrete undertaken by specific clients as part of identity testing? If so, please identify the type of clients, e.g. government body, major contractor. Belgium no; Denmark no; Finland sometimes, special projects; Israel no; Poland no; Sweden no; UK sometimes, special projects.</p>
<p>32. What is your view of the reliability of measuring the total water content of fresh concrete by oven drying? Belgium generally accepted; Denmark +/- 0,01 on W/C-ratio; Finland reliable if big enough sample (5kg); Israel reliable; Poland 95% reliable; Sweden don't know; UK reliable, but depends on assumptions about absorbed water content.</p>
<p>33. If oven-drying is used, what is the test standard? What is the minimum specimen size? Do you know the estimated accuracy of this method? Belgium oven and gas burner - 8kg, 2 hours; microwave - 4kg; accuracy +/- 0,02; Denmark not used; Finland no rules; estimated accuracy (water) +/- 5lt/m³; Israel not used; Poland no standard, performed only for production control; minimum sample size 3.375dm³, 95% reliable; Sweden don't know; UK responding companies had no experience.</p>
<p>34. What is your view of the reliability of measuring the total water content of fresh concrete by microwave drying? Please provide any papers/reports on this topic. Belgium generally accepted, but producers must demonstrate equivalence to oven-drying; Denmark +/- 5 kg/m³ concrete; Finland reliable if careful procedures; Israel no experience; Poland no experience; Sweden don't know; UK not clear.</p>
<p>35. If microwave-drying is used, what is the test standard? What is the minimum specimen size? Do you know the estimated accuracy of this method? Belgium method described in national regulation TRA 550; minimum 4 kg; Denmark microwave Danish standard 423.38; Finland no rules; estimated accuracy (water) +/- 5 to 10 lt/m³; Israel no experience; Poland no experience; Sweden don't know; UK Wexham Developments Rapid Analysis.</p>
<p>36. Are any other methods used to measure the water content of fresh concrete? Belgium others in answer to q30; Denmark no; Finland calculation after measurement of aggregate moisture content; Israel no; Poland no; Sweden no; UK --.</p>
<p>37. How frequently, if ever, is the cement content of fresh concrete measured, e.g. by rapid analysis? If so, what methods are used? Belgium never; Denmark never; Finland never; Israel never; Poland never; Sweden never; UK never.</p>

F. Questions related to conformity of w/c ratio

<p>38. What are national requirements for conformity of w/c ratio (if anything other than the EN206 standard requirements) and for production control? Belgium production control of water content: individual: +/- 14 lt.; statistical (last 100 results): +/- 7 lt. In conformity control: statistical AQL (correction of -0,02). Denmark EN206; Finland EN206; Israel EN206;</p>

Poland National standard PN-B-06265, requirements for bridges and roads concretes; **Sweden** EN206; **UK** no direct conformity requirements.