Resistivity Testing Webinar Q & A - Dr. Jason Weiss, Presenter - April 28, 2022

Can surface resistivity be used for evaluation of existing structures? Like to get an idea about the quality of concrete or how much ions (like chloride) are in concrete. (TX)

Burkan Isgor has done this sort of work for chloride ingress, and several use this for field QC. I will mention that proper sample conditioning is key. Happy to provide more information if this helps.

Do we have any idea on the precision of this test in the field? Are any DOT`s specifying resistivity? (MI)

We have performed several studies on this and FHWA will start a new one very soon. In general, the test itself is about 3 to 4 % variable and improper curing is the largest source of potential error (9% ish) giving an overall error of 11 to 12%. We have had pavers use this to measure consistency and their results are very good. (like 6%). We could walk through this if you like to make sure we have the best plan to test. Our biggest source of issues is labs doing the test or curing incorrectly and we have even designed an item to 'verify the labs'.

Do you know if nano-silica could affect the rcpt values and give false values? (TX)

Nano silica can impact the pore solution as well as the pore path. When there are surface effects that may just alter the surface of the material and not the core so if it's a topical add that should be considered. Alternatively, a close look at pore solution may be in order. For many new materials they should be compared/validated with other tests or other approaches before widespread use is adopted. So, if you want to use this to mitigate sea water ingress benchmarking resistivity to ponding data may be in order. We tended to measure the solution and porosity and use a computational approach in our lab but it's up to the end user as to the method they feel most comfortable with.

For the surface resistivity test is the "a" value related to the maximum size of the coarse aggregate? (NRMCA)

"A" is the probe spacing, this relates to the depth of the electrical field. It should be large enough as to sample a large enough portion of the sample that the aggregate effects are minimized.
If "a" for example is 25 mm aggregate with a MSA of 3 mm are easily distributed but aggregate that are 50 mm would make it possible to have a very distorted electrical field. This is somewhat dealt with in taking measurements every 90 degrees however this needs to be considered. This is an advantage of BR.

FYI for the question on which DOTs are requiring resistivity testing - CDOT requires results to be submitted with mix designs for concrete paving mixes. (CO)

Its great to know that CDOT is requiring this.

How was 91 days established as the optimum specimen age for testing? (WV)

This is simply selected as giving the pozzolans a long time to cure – it's about 3 months. Different agencies allow times from 28, 56, 91 and 120 days. We have not seen a lot of practical difference after 120 days in real curing conditions.

Vacuum saturation seems to be critical. (MI)

Great question – We believe the industry has been doing this 'wrong' for years focusing on vacuum. Placing the sample in a solution is a very practical way that best correlates to how the sample performs in the field. In addition, it removes air variations from appearing in resistivity.

How does the ion concentration affect the SR? (FL)

The ions in the pore solution impact the resistivity of the pore solution. The higher the ionic concentration the lower the resistivity. As such, if you have the same material a water with more ions (salt water for example) has a lower resistivity than the same material with a more dilute solution (like half water/half salt water). As such, materials with higher alkali may not look as 'durable' as materials where the alkalis leach out or where there were less alkalis to start.

Are the resistivity of concrete and grout identical? (FL)

No; there are effects of the aggregates.

Could the delayed ettringite be detected by SR? (FL)

This would require some work; cracking and pore filling could be detected.

How does the amount of the supplementary admixtures affect the SR? (FL)

SCM alter porosity, connectivity and pore solution so this does have an impact.
The general result is that the system becomes more resistive.

Is there a relationship between the SR and coefficient of diffusivity? (FDOT requires 29 kohm-m.) (FL)

Yes, Burkan Isgor and I have published on this and shown the exact solution and some approximations.

Where I work we do SR testing to grout samples for ACP which strength is 8000 psi, sometimes these mixes have Fly ash or meta kaolin, is it recommended to have those 91 values? How can I prove good Resistivity at 28 days during design approval taking in mind it will be much better at 91 days? (FL)

Generally later ages with slow reacting SCM allow them to develop more of the properties they will have long term. Fly ash is a slower reactor. Metakaolin (depending on size and other factors) can be a bit faster. You could develop a ratio of 91 day to 28-day resistivities for a few mixtures to help establish what you are mentioning and there is some in the literature. It does not help immediately but in the long run this can be useful. One approach we have suggested is doing this at the mix design stage and then using the ratio of 91/7 or 91/28 days after that to help with construction testing times.

You mentioned formation factor; can you elaborate on how it is used? (TX)

I think we covered this but the formation factor is the most fundamental parameter. It removes all the effects of the ions/chemistry and makes this just a measure of microstructure. It is a way to normalize the resistivity by the resistivity of the solution. It's the best measure.