UNIVERSITETET I AGDER

BYG507 Forprosjekt til masteroppgave

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Tittel:

Crushed Aggregate

An age sensitive material?

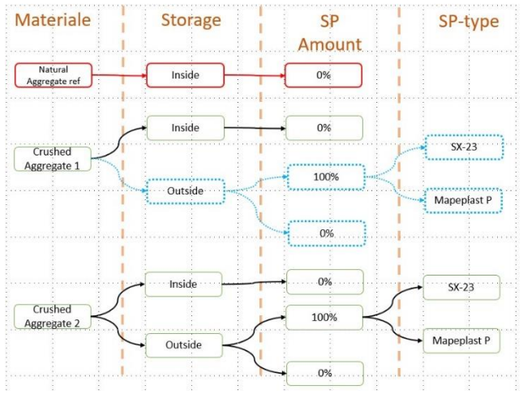
Aggregate is the constituent in concrete that makes up for circa 70% of its volume. Aggregate also represents one of the most valuable parts of the mining industry. Natural sand deposits in the world might seem endless and can be thought as an infinite resource. Due to the concrete production the growing demand for natural aggregate has caused a problem in resource depletion. In Norway, it has been estimated that 80% of all sand and gravel excavated out of nature have been consumed in the generation. This usage has caused a problem where the natural sand and gravel pits have been depleted around populated areas. This does not only apply to Norway, but there are many countries that are facing a shortage of sand and gravel resources, particular to aggregates suitable for concrete production.

Since suitable natural aggregate for concrete is starting to decrease rapidly, it is crucial to find a reasonable solution to reduce consumption as much as possible. Therefore, the production of crushed aggregate can be used to solve the problem. Crushed aggregate comes from crushing bedrock rather than mining sand veins that originated from the last ice age. However, the differences between crushed- and natural aggregate poses a challenge that needs to be addressed.

In recent years there has been more and more focus on shifting natural aggregate to crushed due to the depletion of natural gravel pits in Norway. There are many differences between crushed and natural aggregate which need to be addressed. One different which is a rumor is that the crushed aggregate can change its effect on workability based on its age. When the aggregate is freshly crushed it gives the concrete a worse slump than if the material for time to “mature” for some weeks. This paper looks at what causes this rumor based on the rumor that something is happening to the crushed aggregate over the time it has been stored.

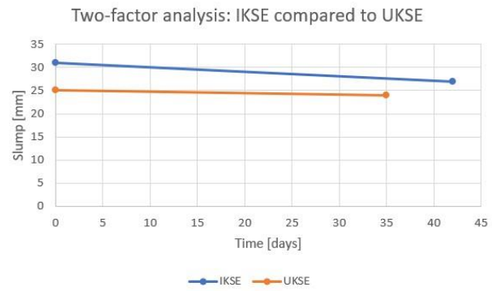
In this preliminary project, the goal is to pinpoint where such a rumor might come from based on lab tests. The project is also closely tied up for an upcoming master’s thesis on this subject. The research question is as follows: ***How will the rheological behavior of fresh concrete be altered due to maturing and environmental exposure of crushed aggregate?***

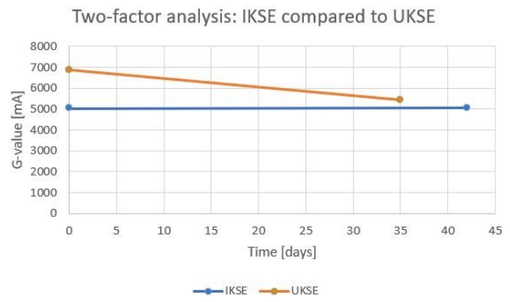
To determine the reason why it seems like the aggregate is “aging,” the preliminary experiment was constructed to test changes over time when the crushed aggregate was stored inside, outside, and when the mortar tested had added superplasticizer.

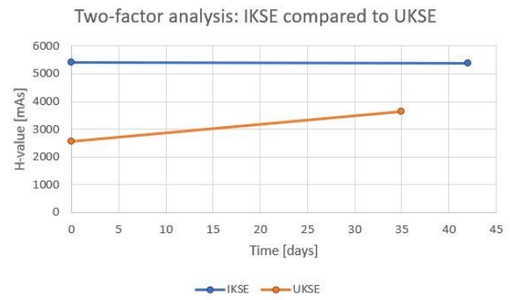


The freshly mortars were tested by using both the mini-slump cone for slump and width development and with ConTec Rheometer-4SCC for G- and H-value which represent Yield stress and Plastic viscosity, respectively.

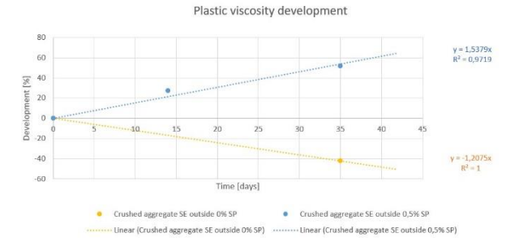
The results from the experiment are analyzed by using both simple regression analysis and two-factor analysis.

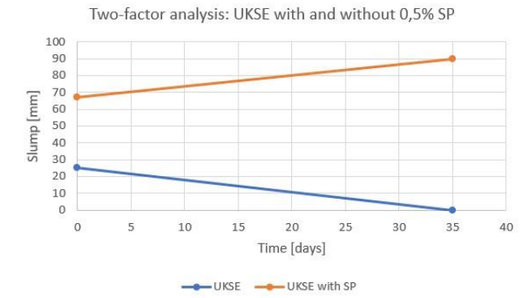






The analysis shows that storing method did impact the aggregate. By storing the aggregate outside compared to inside, both the plastic viscosity and yield stress showed a significant change in both regression analysis and two-factor analysis. Looking at the slump and width did show a slight change. Moreover, the Correlation factor R^2 was low on every test, meaning the trend line may be wrong.





When adding SP, both the yield stress and plastic viscosity change drastically, and both the slump and width had increased. R^2 were much higher in these tests and the regression line and two-factor analysis correlate with each other. The downside with the experiment performed is a low number of results over time. With a more detailed testing sequence, analysis would be more accurate and would give a better result.

In the hunt for the cause of the rumor, these test results show that the cause may be due to how the crushed aggregate is stored. When stored outside, the aggregate is open to the weather conditions in the area, meaning rain could have washed away some fines or that it could have discharged the aggregates electrical charge from the crushing process.