



THE PAIRING OF THE VERTICAL SHAFT IMPACT CRUSHER AND THE FLAT SCREEN IS A WINNER FOR THE PRODUCTION OF AGGREGATES OF HIGH QUALITY AND, ESPECIALLY, FOR "PERFECT" SAND AND FILLER RECOVERY THAT WOULD END UP IN THE SLUDGE TO BE DISPOSED OF.

The technology of the vertical shaft impact crusher guarantees the versatility of the product with a flattening index <= 95% and a crushed sand that competes in quality and smoothness with the natural one. Unlike the hammer mill whose grain size of the output material depends on the wear of the hammers, the grain size of the output product of the vertical shaft impact crusher does not depend practically on wear, but only on its speed of rotation, so it is very simple, by varying the speed, to produce either grits or sand of constant quality.

The use of vertical shaft impact crushers as finishers significantly **reduces the production of fillers** (<63 microns) compareed to more traditional hammer and/or bar mills. In addition, this type of mill **can recycle**, eliminating **the fraction 4-8 mm**, almost always present as excess in the crushing processes.

The grain size of the sand produced is not left to chance, but is reassembled before sending it to stock to ensure that its grain size curve is constant and whitin the melt of the fineness

modulus. The secret for this result is the high performances combination between Cedarapids horizontal screen impressive quantities at 2 mm and the ability of the vertical shaft impact crusher to crush the excess of 2-4 mm. Weighing the 0/2 sand that goes to stock you can add the 2/4 fraction needed to keep the final 0/4 sand inside the spindle of the fineness modulus and recycle the excess of 2/4.

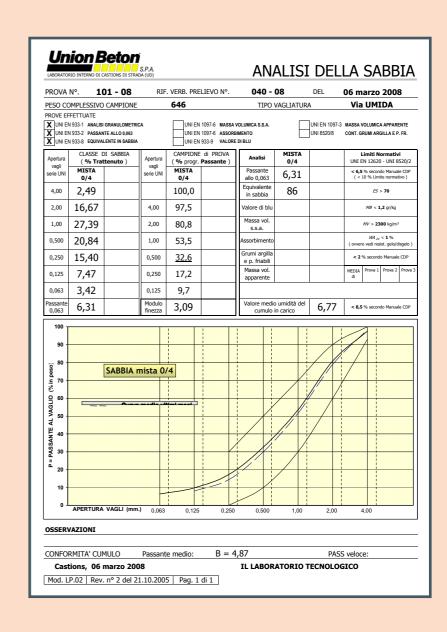
Operating in this way **the product remains constant over time** even by varying the feeding curve. It does not seem superfluous to remaind you that some competitors trying to realize the same project using mills and screens of their own production find themselves with monstrous circulating loads at the expenses of production and economic result.

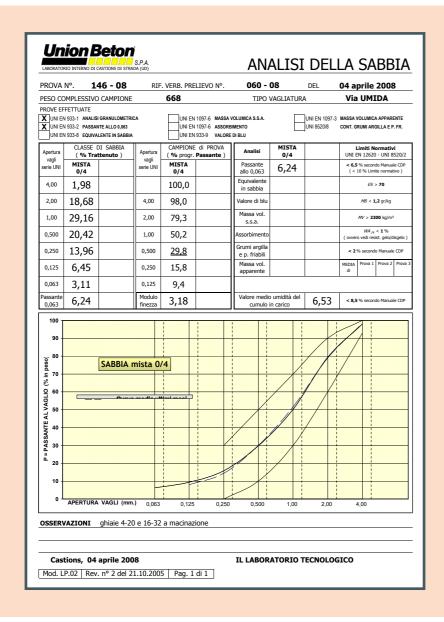
The ISO standard allows to have uo to 10% filler (<63 micron) in concrete sand, while only 2% in washed sand normally ramains. ICM has developed this process, especially for plants that work with alluvial material: washing all the aggregate at the entrance

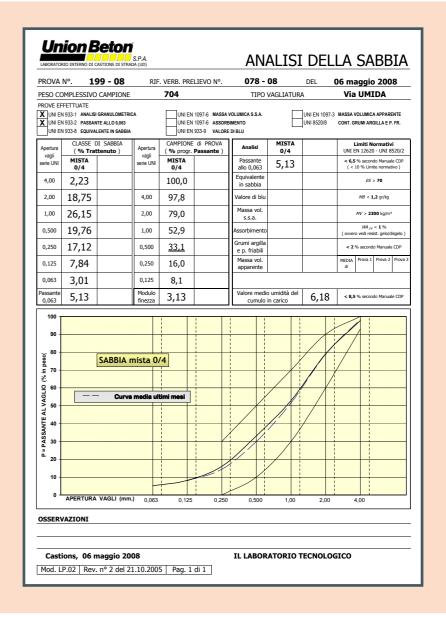
to eliminate any silt and organic materials, the natural sand is then washed and practically without filler.

Before sending the sand to stock, we blend the natural and the crushed sand so that the recomposed aggregate has the filler percentage in line with the standards. If the crushed sand is in excess over the natural one, a portion will have to be washed. Depending on the capacity of the plant, it means recovering tons per hour of material to be sold as a product rather than disposing of it in sludge.

We have more than one plant in operation that uses this technology with success and great satisfaction of our customers. Below are the particle size analyses of a plant that has been using this technology for many years and you can see how the particle size of the sand is centred in the molten and constant over time.







OPTIMISATION OF THE SANDS

While we all know that concrete is a mixture of grit, sand, cement and water, perhaps not everyone knows that high quality sand allows to reduce the percentage of cement in the mixture for the same concrete's strength.

Two types of sands are normally used: the natural one found in alluvial deposits and the one obtained from crushing.

Basically, to be a product of quality, sand must have a particle

size distribution which curve is whitin a spindle recognized by the standards and has a fineness modulus between 2,3 e 3,1. It is generally indicated as sand the fraction of aggregates that has the diameter between 5 mm and 0. What normally happens in the quarry is: you screen at 5 mm and the passerby is indicated as sand, whether natural or crushed, but when you do the particle size analysis you see that its curbes do not remain

included in the melt of the standard, both because natural sand is monogranular and because crushed sand is too rich in the fraction 2-5 mm.

The only way to bring these sands back into the curve is to correct them by adding the missing fractions to the monogranular sand and eliminating the excess fractions in the crushed sand.

The theory is very simple, but putting it into practice requires the solution of very complex problems such us screening at 2 mm and crushing the 2-5 mm fraction.

In order to screen at 2 mm, a very high performance sieve is required, otherwise a lot of the finished product is rejected and the recirculation increases exponentially.

The traditional machine for crushing the 2-5 mm fraction is the bar mill, wich consumes a great deal of energy, has a marked

wear and tear, and a modest production. ICM has been able to solve this problem thanks to two machines with exceptional performance: The Cedarapids horizontal screen and the vertical axis mill. The Cedarapids screen is an excellent 2 mm screen and the vertical axis mill shatters the 2-8 mm fractions with low wear and tear, and energy consuption commensurate with production.

The next step in optimizing the production of sand was the recovery of the crushed filler. The standard provides that, in concrete sand, there is up to 5% of crushed filler (called filler the sieve pass 0.075 mm) but normally the sand is washed and this filler is lost in the water.

ICM has developed a system that allows it to recover large quantities of product that were previously lost with washing

water and now enrich the sand in the fine fraction. The system is very simple: all the incoming natural sand is washed, to eliminate all the silt. This sand is then separated from the filler (0 - 0.075 mm) in the cyclone, compliting removing it.

Different is for the crushed sand proceded, wich is dry and rich in filler. To mainain the standard percentage of filler in the final product, only a fraction of the crushed sand is washed, and then blended with the natural sand.

Let's suppose that a plant produces 600 tons/h of sand, 50% of which is natural and 50% is crushed. It is reasonable to expect that 10% filler is present in the crushed sand, which means 30 tons/h of filler. If I wash all the sand, which is natural and crushed, I will have a final sand with 0% filler, the 30 tons/h of filler ends up in the filterpress and must be disposed of.

On the contrary, if we wash all the input material and only the natural sand, the crushed sand filler is "clean" and in compliance with the regulations.

Joining the two sands I will have a recomposed sand with 5% filler, 30 ton/h on 600 ton/h of product. It is 30 tons/h, which brings a triple benefit: they increase sand production by 5%, improve the curve and reduce the amount of sludge to be precipitated, pressed and disposed of.

A plant with these numbers has been in operation since 2004 and you can see in the article Union Beton (attached above, the curves of the sand taken in different months). It is very easy to see the constancy in time and the positioning of the center of the spindle which value we leave for you to judge.

FINENESS MODULUS

The fineness modulus is an empirical coefficient obtained by adding the percentages of retention in a series of preestablished sieves and dividing the sum thus obtained by 100. For concrete sand it must be between 2.3 and 3.1.

The fineness modulus gives an indication of the size of the inert surface and its workability in the mix. Not more than 45% shall be retained between two consecutive sieves.

The sieves used in ASTM C33 are #100 (149 microns), #50 (297 microns), #30 (569 microns), #16 (1.19 mm), #8 (2.38 mm), #4 (4.76 mm), 3/8" and higher in a ratio of 1 to 2.

ASTM C33-71A CONTROL SPINDLE

Sieve	Through percentage
3/8"	100
#4	95-100
#8	80-100
#16	50-85