# RE[4] Project

## REuse and REcycling of CDW materials and structures in energy efficient pREfabricated elements for building REfurbishment and construction

| D2.3<br>Innovative strategies and processes for separating CDW based on weight criteria<br>Public summary of deliverable | |
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## *Summary*

The objective of this work package was to use dissimilar methods of sand washing and separation to understand and acknowledge if they can be integrated into the current CDW washing process.

CDW washing and recycling of useable and valuable material can be a very difficult process due to the constant variation that comes with the feed material. Recycled 0-2mm sand can be quite hard to sell due to it being of low quality compared to virgin sand. For this objective, it was required to find new and innovative processes that can be implemented into the current CDW sand washing process, and improve the quality via integration into an existing CDW wash plant.


## *Identification of Innovative processes*

Three processes were analysed to show their performance when challenged by handling CDW materials.

- Attrition scrubbing
- Spiral separation
- Counter Flow Classification Unit

The aim of this testing is to establish a good correlation within the test results and prove that these innovative processes can be employed into the current worldwide CDW washing process.

## *Attrition cell testing introduction*

Attrition cells are generally implemented into a sand washing process mainly to reduce product turbidity, and to break apart loosely conglomerated clusters through a high shear environment. This process is effectively a priming process to remove contaminants from fine material feed. This ensures production of consistently graded material, to maximise the efficiency of the successive washing processes.

CDE currently produce “Shearclean” attrition cells, this modular type component can be easily placed within a washing process to scrub material, enhance efficiency and increase potential yield.

A single attrition cell that could replicate the current industrial sized plant was used. A variation of material could then be fully tested on the individual cell. To improve the process, the focus must be in producing a higher quality product of sand.

A variation of sand samples will be processed at periodic times through the attrition cell to determine the most influential and optimum timeframe of scrubbing. This in hindsight will control the retention time needed within an attrition cell to prepare 0-2mm material for further separation within the washing process line.

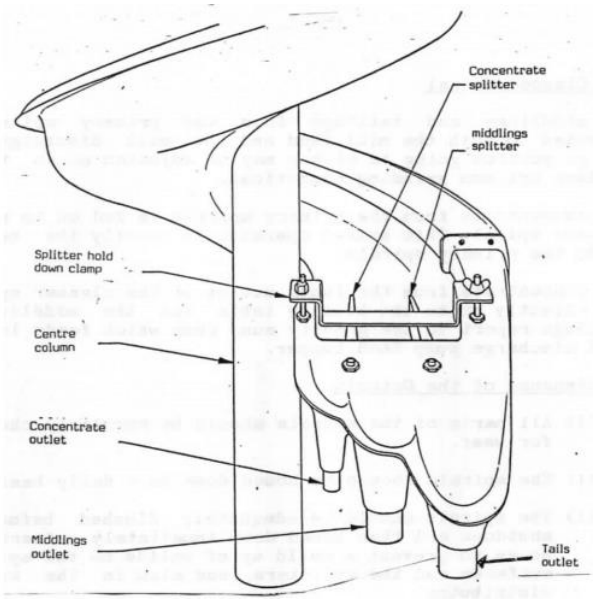
## *Spiral separation method introduction*

Spirals have a common place within sand separation throughout the world, frequently incorporated into CDE wash plants, particularly within the glass sand industry.

For spirals to work efficiently the material being fed must remain consistent, this is achieved through the attrition cell before being transferred for spiral separation. The heavy material will fall to the inside of the spirals, likewise the lightweight material will fall to the outside of the spiral, hence creating the separation.

Due to spirals being placed downstream of the attrition cells, the sand and organics will no longer be clustered together, which means the spirals can accurately separate the two.

The diagram below shows the basic principal of how spiral separation works. The light particles (organics) move to the outside of the spiral, the middle is contaminated with both heavy and lightweight material and then inner spiral is where the heaviest particles will be, in this case this is where the high quality sand will be found.




## *Counter flow classification unit introduction*

Counter flow classification unit (CFCU) technology is tried and tested across the world on many different applications including golf sand production, glass sand production and lignite removal projects.

The aim is to incorporate a CFCU unit within the CDW washing process to remove organic and lightweight waste material.


The CFCU process provides a means of density separation and its basic operation involves floating the lighter organic particles off the top while the sand product (being heavier than organics/lightweight waste) sinks to the bottom of the tank .

CFCU performance was replicated using a lab scale CFCU to separate the organic material and lightweights from the useable sand. This Aim is to remove lightweights and organics from the process by removing the 0-250um size material, the 0-250um can then be transferred to a screen to recover the water/sand lost from this initial cut achieved by the CFCU.

Samples of the overflow/lightweight material will be gathered periodically to allow for irregularities in the system. It is anticipated that this will be the "final separation" within the CDW washing process.

## Testing plan

Each process will be subject to a various number of tests using different feed materials from various sources within Europe. A correlation of results will be achieved to reach a conclusion of whether the certain plant item has a positive influence on the produced material. (0-2mm sand product).

## Attrition test procedure and analysis

CDE carried out testing of the sample delivered for different periods of time (3, 6, and 9 minutes) to see the effects attritioning had on the material. The sand was graded to 6.3mm to protect the attrition cell and was rinsed over a 63 micron sieve to remove the loose clay.

The rinsed sample was weighed into 3 sets of 15kg ready to be attritioned and a 5kg sample to act as the control before scrubbing. The following table shows the comparison of the raw material sent to CDE vs. the attritioned samples.

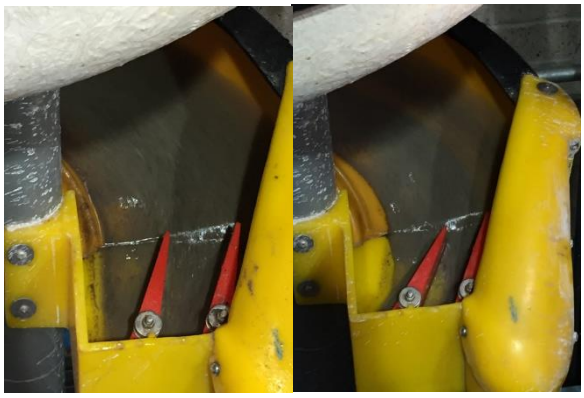
| Sieve Size (mm) | 3 MIN (% Passing) POST-ATTRITION | 6 MIN (% Passing) POST-ATTRITION | 9 MIN (% Passing) POST-ATTRITION |
|---|---|---|---|
| 8.0 | - | - | - |
| 4.0 | 100.0 | 100.0 | 100.0 |
| 2.0 | 91.7 | 91.5 | 93.5 |
| 1.0 | 68.9 | 70.2 | 72.8 |
| 0.500 | 46.4 | 49.4 | 50.9 |
| 0.250 | 25.6 | 28.8 | 29.3 |
| 0.125 | 13.5 | 15.9 | 16.0 |
| 0.063 | 6.8 | 7.6 | 7.8 |
| 0.038 | 0.6 | 0.8 | 0.8 |

It is clear to see that the 9min sample has yielded the finest material, however attrition longer than 9mins would not be worth undertaking. The picture below shows the organic material floating on top of the now

attritioned sand.

## Spiral Testing

The 9mm attritioned material was split into two batches to undergo spiral separation. One batch underwent an aggressive cut (left photo), whilst the other was conservative cut of material (right photo).



It is worth noting in this case, it is the light material is the waste and the heavy material is what is desired. The more aggressive the cutpoint, the less heavies obtained and therefore the smaller the yield. This is observed in the following tables.
Aggressive is table 1, conservative is table 2.

| Sieve Size (mm) | Heavy Material (% Passing) | Light Material incl. Organics (% Passing) |
|---|---|---|
| 4.0 | 100.0 | 100.0 |
| 2.0 | 99.6 | 93.6 |
| 1.0 | 93.6 | 69.2 |
| 0.500 | 79.8 | 43.7 |
| 0.250 | 56.4 | 18.2 |
| 0.125 | 30.7 | 7.2 |
| 0.063 | 9.5 | 4.4 |
| 0.038 | 0.1 | 0.1 |

| Sieve Size (mm) | Heavy Material (% Passing) | Light Material incl. Organics (% Passing) |
|---|---|---|
| 4.0 | 100.0 | 100.0 |
| 2.0 | 99.1 | 90.5 |
| 1.0 | 91.7 | 52.8 |
| 0.500 | 73.0 | 23.3 |
| 0.250 | 40.2 | 11.9 |
| 0.125 | 18.5 | 9.1 |
| 0.063 | 7.4 | 4.3 |
| 0.038 | 0.1 | 0.6 |

## Density separation

The washed sand entered the CFCU, and whilst water is pumped in with an upward flow at a constant rate, a bed of sand is built within the tank. Less dense material is then overflows a weir where it will then be taken to another part of the recycling process to be recovered.

By keeping the upward flow of water constant, the bed depth can be controlled to change the settlement rate of the sand. The higher the bed depth, the slower the settlement rate of the sand and hence more overflow. Typical cutpoint of the CFCU is 125 to 250 microns.

## Conclusion

To conclude, it is evident that an Attrition cell, with an attritioning period of 9 minutes is ideal to help further separate all clay bound organics and fines.

The spiral unit would be the next stage in processing the material whereby the separation of particles occurs according to specific gravity and the heavier minerals progress to the inner profile while lighter material and organic are forced towards the outer profile, along with most of the water.

Finally, the counter flow classification unit would remove the remaining organics and some of the bottom end of the sand in order to create a coarser, higher quality 0-2mm sand.

It is also worth noting that all the machines used for this process can be altered during commissioning to meet the necessary specifications of the sand.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