Construction, Demolition & Excavation Waste Recycling: An Introduction

Overview of the salient considerations and drivers relevant to the success of initiatives to recycle and re-use construction materials.

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1. Introduction

This discussion on the processing of Construction, Demolition & Excavation Waste (C&DWR) is intended to give the reader a brief and high-level overview of the key market considerations that may help determine the current potential for viable / successful installation of such systems in any given economic environment.

It can be observed that C&DWR has become a major sector within the aggregates and construction materials sectors of numerous countries whilst many others have yet to begin such recycling or move beyond the more basic approaches. In producing this document, the author has mainly drawn on experience of the UK market where C&DWR has been established at an advanced level for over a decade and is widely used as a benchmark for such development in other countries.

2. The main drivers towards recycling / enhanced recycling

2.1 Sustainability

After air and water, aggregates are the most used raw material in the world

Average European demand is 6 tonnes of aggregates per person per year

In many markets, virgin aggregates are understood to be a finite resource. Even at a global level, viable extractive sources close to population centres (where the materials are mainly required) are under increasing pressure. Countries with limited aggregate resources, population, and economic growth are likely to see aggregate (and therefore construction) process rise as aggregate stocks dwindle and they become increasingly reliant on imported materials.

'Recycling of aggregates has the most significant impact on the long-term sustainability of aggregate reserves' SEPA (Scottish Environmental Protection Agency)

Demolition activity is present in all markets, whether developing or already highly developed. This presents a ready source of potential construction materials. Rather than being perceived as waste, successful recycling comes when such materials are correctly understood to be a resource.

Above we have touched on the sustainability of aggregates, but it is also important to consider the sustainability of the sites used to *dispose* of C&DW materials. In most markets such materials are sent to landfill, used to backfill mines or quarries, or simply stockpiled. Each of these approaches brings its own potential difficulties. In the case of landfill or backfilling, space ('landfill void life') may be limited, and there is a land cost to opening up new facilities. The EU generates over 1,000 million tonnes / ~550 million m^3 of C&DW material every year, enough to fill 220,000 Olympic size swimming pools. Stocking such material in open spaces presents potential environmental issues with wind-blown debris and the potential for wildlife and/or roaming livestock to ingest inorganic materials. In all cases, unless there are correct controls in place there is also a risk of contamination of the earth ground water and river courses, with residual hazardous materials including but not limited to asbestos, heavy metals, petrochemicals.

2.1.2 Strategic Considerations

As noted in section 2.1, markets with limited virgin aggregates reserves will eventually (or already) face the need to acquire construction materials from outside their borders. Of course, countries import many items and this is not itself a negative issue given that trade typically operates in two directions. There is however a potential political consideration in the extent to which any country may feel comfortable outsourcing a large percentage of its construction materials. When price and availability are completely in the hands of another territory, there is clear potential for conflict with, or leverage by, the supplying country. One step to mitigate this situation is to take all possible measures to maximise the usage of internally sourced materials; ensuring that what aggregates are available locally are processed and used in the most efficient manner possible, and that any potential substitute material options are investigated. Recycled sand and aggregates present a ready source of such material for a wide range of uses within the construction sector.

2.1.2 Environmental Considerations

The potential environmental impact of C&DW disposal is clear in terms of unregulated tipping, the significant landfill space taken up, and the potential for contaminant materials to affect the wider environment, soil, groundwater, river courses and sea.

It is also important to consider the environmental cost of virgin aggregates extraction. Bringing rock from its natural state into a market ready aggregate involves multiple stages of blasting / excavation / digging, crushing, screening and potentially washing. This process is a significant energy consumer through the use of electrical plant and diesel-powered machinery. In most countries, the sources of sand and aggregates are somewhat distant from their point of final use near population centres. This adds a further stage of fuel usage (for transport) in their handling. The carbon footprint of our construction aggregates is significant and should be factored into any analysis. The (UK) Mineral Products Association 2009 Sustainable Development Report noted that each tonne of sand/aggregates produced was responsible for 4.28kg of CO_2 emissions, not including transport to site.

3. Barriers

The above considerations present some clear motivators to move towards efficient C&DWR for any market. We must however consider the potential barriers / market forces that can be seen to limit the wider uptake and utilisation of such systems.

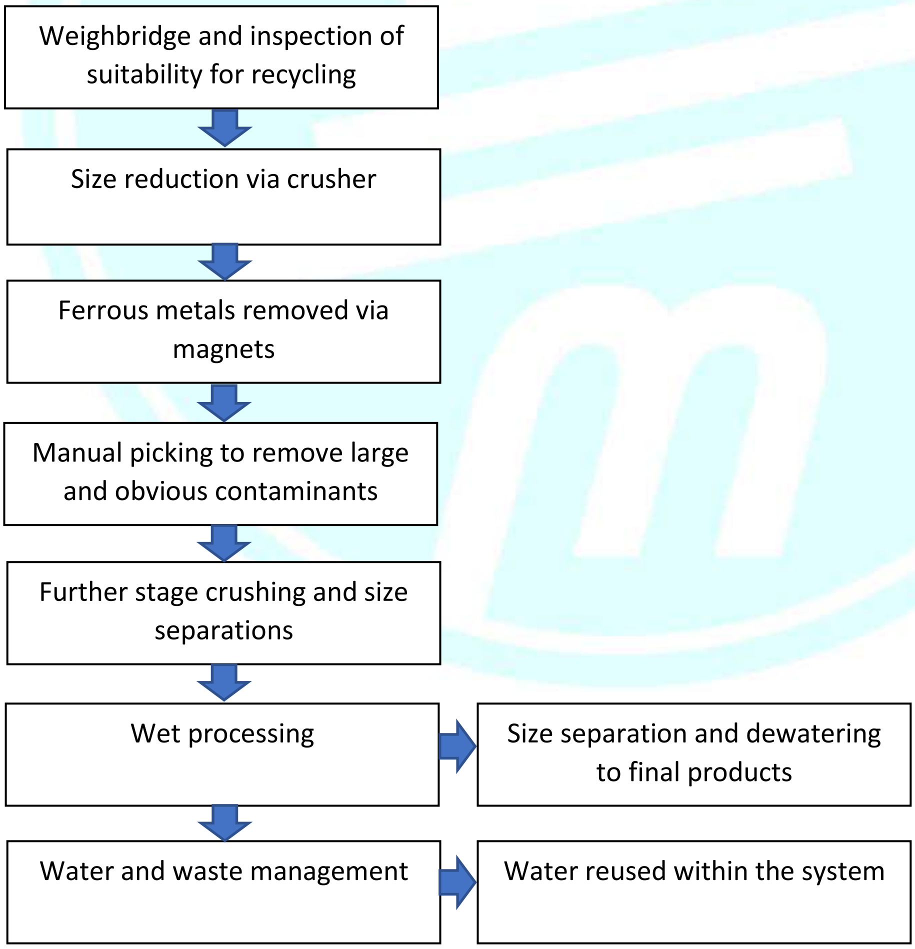
Issue	**Potential mitigations (by Govt.)**
Ready and low-cost virgin aggregates available	Restrict use of highest quality materials to only those applications where they are required, for example structural concrete, whilst demanding a % of recycled materials where they are suitable, for example road furniture, non-structural concrete Consider taxation / levy on virgin materials (as with the U.K. Aggregates Levy).
Commodity value of recycled aggregate products prohibitively low to attract investment	Subsidise production of certified quality recycled materials Force demand by demanding contractors use a certain % of certified recycled materials in their projects (where appropriate) Introduce certification processes to underscore the quality and viability of recycled materials produced to the correct standard
Demolition material is low or no cost to dispose of	Introduce tipping fees and penalties for evasion / fly-tipping
Capital investment requirements for equipment and facilities	Offer land for recycling centres at low or no cost Consider Govt. subsidies towards appropriate capital investment (for example, using any monies derived from an aggregates levy)
Uncertainty around potential usage / markets for recycles products	Initiate a certification and standards programme including a list of suitable uses / end products where recycles materials can be used to a given %.

4. The Process

The format of CD&WR systems varies according to the specific nature of the materials arriving to the facility. In most markets such material is, by definition, highly variable and this is a critical aspect to consider within equipment and process selection. Materials are typically contaminated with paper, wood, plastics, metal fractions, polystyrene and much more.

Ideally materials should be segregated as early in the process at possible. Best practice would see this done at the demolition site with various main materials separately stockpiled by an excavator with a well trained operator. This minimises the amount of low grade / undesirable material being carried forward to an aggregate recycling system, for example, plasterboard, wood, rebar, and steel can be separated and otherwise addressed. The construction material elements: concrete, masonry, brick, foundation soils etc. can be size reduced on-site with excavator attachments making the material easy to load to trucks for transport to the recycling centre.

The simplified schedule below shows the typical format of C&DWR systems now most commonly installed in the U.K. Until ~2005 most systems were based on only dry processes and this remains an active albeit declining sector. It is also the one most observed in markets where materials are recycled at a relatively low level. In such cases the final two stages from our figure are not included. Inclusion of these steps does however give the most complete and efficient approach, the merits of which are described in the next section.



4.1 Limitations of the ‘dry’ crush and screen method

The most rudimentary approach to C&DWR is to crush and screen the material to produce the size fractions required for the construction sector. This cannot fully address the aforementioned contaminants usually found in such material (paper, plastic, wood, organics etc.). In such systems it is common to reject all material <10mm as waste as it is generally of a very poor grade due to high contaminants, soil, silt and clay content. This fraction can ‘typically’ represent 40-50% of the incoming material and is therefore a clear potential resource. In rejecting this fraction, dry systems generally recover only 50-60% of the overall resource. Furthermore, the end products generated are typically low quality, due to notable content of the mentioned contaminants. This has an adverse effect on their utility and potential market value. Some of this is mitigated through flotation units / air separators. Whilst this does see some notable improvement it does so to a lesser degree than full ‘wet’ processes, cannot equally address the presence of clays and does not offer commercial quality sand fractions.

4.2 Advantages of wet processing

Washing the materials brings a number of key advantages, borne out by the increasing number of such systems installed within the EU (and some other countries) in recent years, particularly within the last decade.

The most obvious gains to the processor are in production quantities and quality. Product to waste ratios are dramatically improved versus dry systems as all viable material >0.063mm material is retained as commercial product or segregated by product. If we consider a typical UK installation, the fines (<0.063mm) fraction may be measured as around 20% of the overall feed. This means an additional 20-30% production versus a dry system where the <10mm is rejected as waste.

Quality gains are also highly significant with a properly specified wet process. The noted contaminants are removed through a combination of scrubbing, flotation and screening, and presented as a by-product ‘trash’ stockpile. Some operators are able to dispose of this as a waste to fuel resource, depending upon its composition. The resultant aggregate fractions are physically and visually higher quality making them suitable for a wide range of non-structural applications, whether for sale to the construction materials sector, or for use in-house in the manufacture of sellable value-added products.

Wet systems additionally offer the producer washed sand product which can also be used in non-structural concrete applications. Depending upon the chosen configuration (and raw material characteristics) the system may produce one (usually <5mm) sand product or two grades of sand: <5mm and <2mm. The former has commercial value in non-structural concrete manufacture and the latter can be used as pipe bedding and for cable laying.

Having water within the circuit also facilitates the additional targeting and removal of non-inert contaminants such as heavy metals, residual chemicals, and hydrocarbons.

4.3 Barriers to Wet Processing

High performance wet systems carry higher capital investment requirements versus entirely dry systems due to the additional specialist equipment required. (Section 4.2 underlines how the return on investment is likely to be superior with a wet system).

4.3.1 Availability of water

Naturally, a wet process does require a source of water and this can present a notable barrier in some markets. Even in temperate climates, recycling facilities are often located in areas adjacent to population centres and large volumes of water may not be readily available. In arid countries there are other obvious limitations and costs associated with water supply. Fortunately, this can be largely mitigated through the use of advanced water management systems at the final process stage, with up to 95% of all process water being internally recycled. The cost of top of water is acceptable in the majority of cases when set against the commercial benefits of using a wet system.

5. Conclusions and possible recommendations to enhance the recycling environment

There are clear and compelling arguments in favour of C&DWR both at a level which might trigger governmental interest (protection of resources / self-sufficiency / environmental aspects) and at a private investor level (production of an in-demand product from a low cost and readily available resource). However, for any consideration to move from the hypothetical towards actual installations we can see that the presence of the factors noted in Section 2 will be the determinants.

To consider what is required to make C&DWR work at a country level, let us look at what would represent the 'ideal scenario'. Some of these may be considered as options / recommendations for markets interested to create a viable dynamic.

1. Limited and / or high-cost virgin aggregates available (if necessary, through imposition of a levy)
2. Use of virgin aggregates in non-prime applications is forbidden
3. Quarries are in remote areas, some distance from population centres
4. Clear and recognised usages for recycled aggregates exist
5. Recycles aggregate producers can have their products certified
6. Hard targets are set for the usage of recycled materials and minimum percentage requirements are built into Government sponsored projects (to force demand)
7. Recycled products have strong commercial value (step 6 may be a driver for this, alternatively Govt. subsidised production could be considered. The costs of such intervention could be offset against the sustainability, strategic and environmental gains).
8. Demolition waste attracts a gate fee / tipping charge for disposal
9. Capital grants / finance schemes are made available for early adopters

6. Further Reading

Construction Resources and Waste Platform, Overview of Demolition Waste in the UK:
https://www.wrap.org.uk/sites/files/wrap/CRWP-Demolition-Report-2009.pdf

Circular Economy on Construction and Demolition Waste: A Literature Review on Material Recovery and Production:
https://www.mdpi.com/1996-1944/13/13/2970/pdf

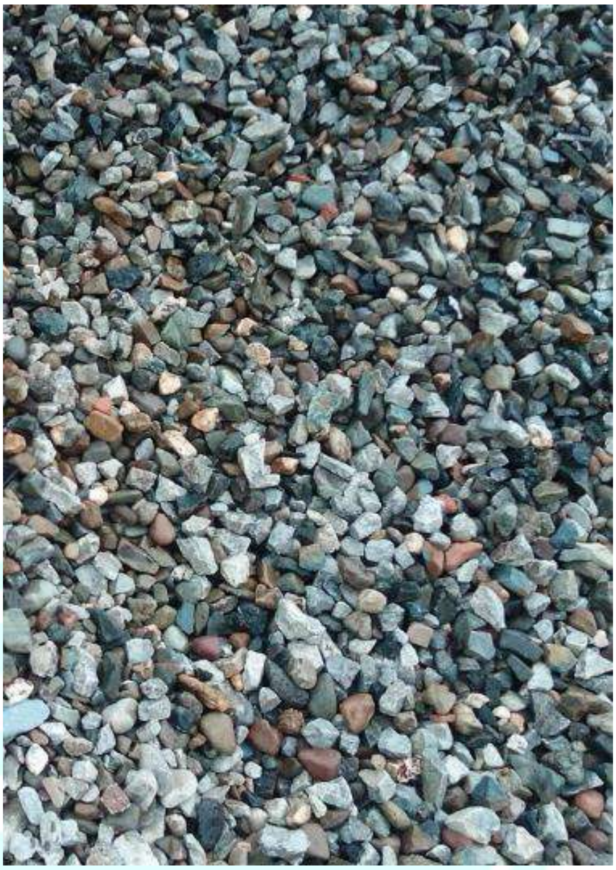
European Environment Agency, Construction and demolition waste: challenges and opportunities in a circular economy:
https://www.eea.europa.eu/themes/waste/waste-management/construction-and-demolition-waste-challenges
European Commission, Development and implementation of initiatives fostering investment and innovation in construction and demolition waste recycling infrastructure
https://ec.europa.eu/environment/waste/studies/pdf/CDW%20infrastructure%20study.pdf

Department of Architecture Constructions. Polytechnic University of Madrid (U.P.M), Madrid, Spain
Sustainable construction: construction and demolition waste reconsidered
https://core.ac.uk/download/pdf/148657107.pdf

7. Appendix

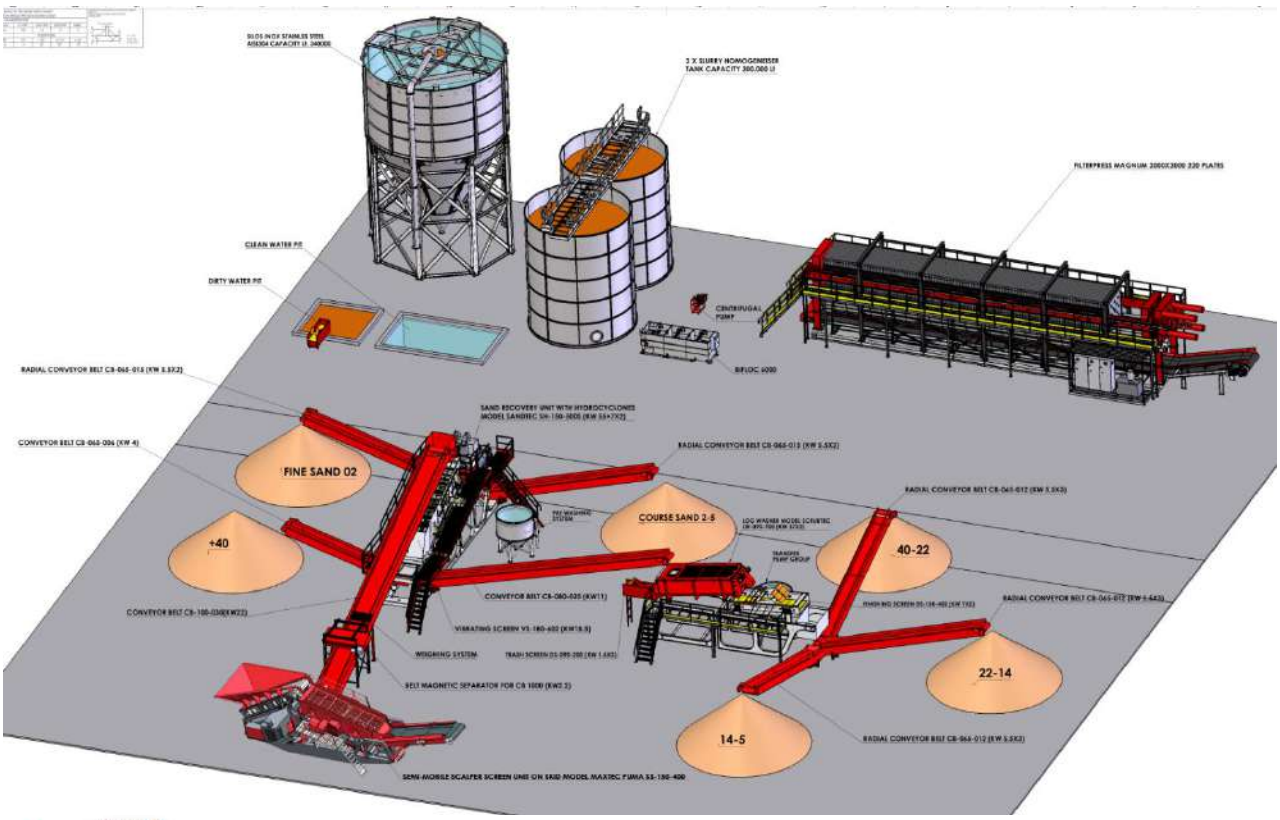
7.1 C&DW material example before and after processing with a washing system

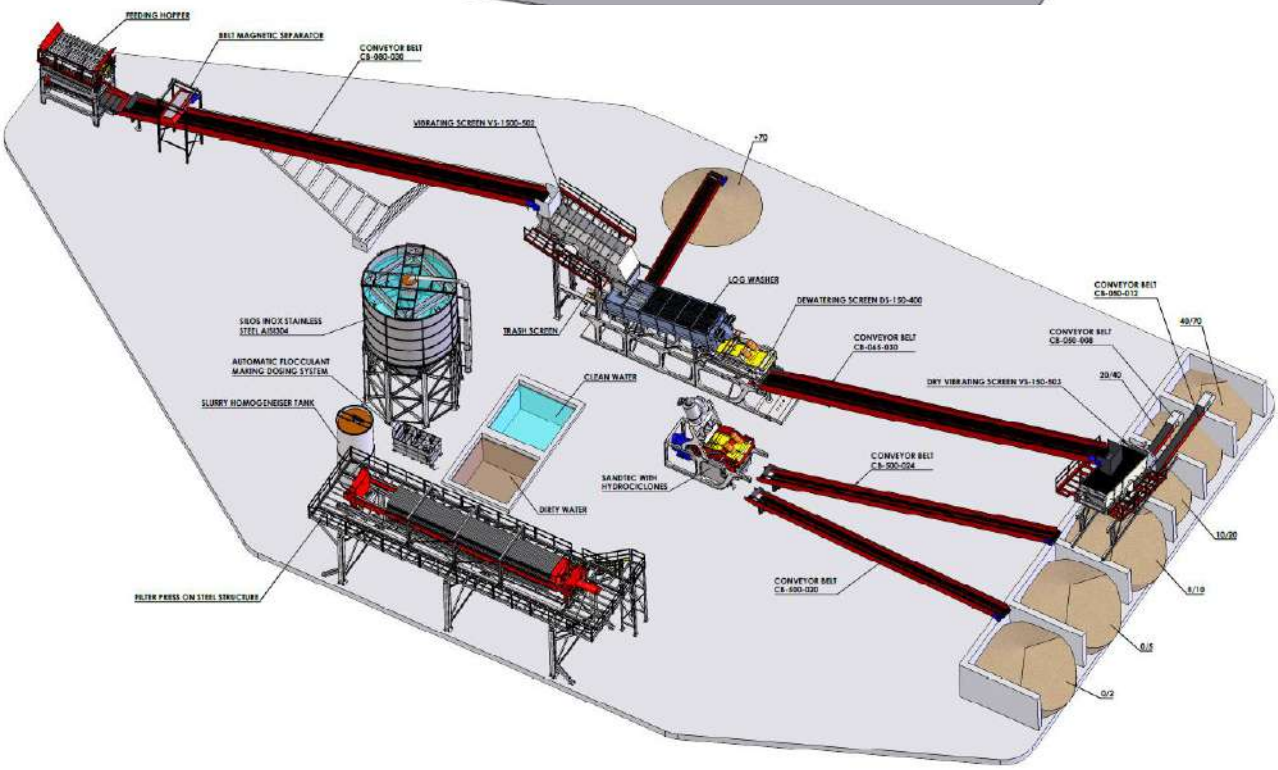
Incoming C&DW material



Finished aggregate product (wet system)

7.2 Example Matec Corporation C&DW plant layouts





7.3. Key Equipment

7.3.1 Matec Scrubtec: Logwashers

Matec's Scrubtec logwashers are specifically designed for mined and quarried materials with persistent and difficult clay or soil adhesion. The Scrubtec, which is slightly inclined in configuration, consists of a main 'tub' containing two parallel shafts equipped with extremely abrasion resistant hi-chromium blades. Material, usually <100mm (4") is fed to the unit by conveyor, or in some cases a pre-screen, and water is added. This forms a fluid bed within the unit in which the shafts and blades are mostly submerged. The shafts counter-rotate with the blades aggressively thrashing the slurrified material and promoting considerable material-on-material contact. The design and motion of the blades also draws material up and out of the main discharge point, releasing highly scrubbed material with some residual liberated fines and water. Material is usually then discharged to a dewatering screen equipped with spray-bars to polish the product and remove any residuals. There is also an outlet at the rear of the unit, effectively an overflow weir for water, fines and floating contaminants. This is removed and taken to the sand processing circuit (if included).

Fig 4. Scrubtec with pre-screen

Scrubtec's ability to efficiently remove floatable contaminants has made it a key component within recycling systems for construction, demolition, and excavation waste operators. In these applications the overflow from the back of the log washer is passed to a dewatering screen to capture the floating contaminants. Undersize and water from this 'trash screen' is collected and kept with the sand and water phase of the process.

Fig 5. Scrubtec with dewatering screen

In keeping with the wide range of sectors, material types and capacities that Scrubtec serves, a wide range of units is available, from the 70tph 0.8mx5m (2.6'x16.4') LW-080-500 through to the LW-120-700 1.2mx7m (3.9'x23') unit capable of handling 220tph.

7.3.2 Hydrocyclone based washing units

Cyclone based washing units have become the industry benchmark over the last 20 years and particularly in the last 10 years. Originally more common within mineral processing environments they are now a common site in virtually all sectors of wet processing. Cyclones are based on the separation of low mass particles via centrifugal force. Their 'forced' separation of particles makes them significantly more efficient and accurate in removing the targeted excess fines than conventional 'settlement based' sand washing systems. For example, Matec's Sandtec range of hydrocyclone based washing units are assured to achieve 97% efficiency in separation i.e. >97% of the removed solids as waste will have a particle size smaller that the targeted cut-point. In the common targeted cut-point of 75µm the customer might expect to find <3% of the 'waste' material to be larger than 75µm and nothing more than trace to be found >100µm. This is a significant contrast to the screw classifiers and bucket wheels where much larger particles will be lost in notable volumes. Indeed, in many cases customers install a Sandtec downstream of a screw classifier to recover the commercially viable fines that would otherwise be lost.

The cyclone is however just one element within these units which in total comprise a main reception sump (for sand and water); a sand slurry pump; the cyclone(s); a dewatering screen. Sand slurry is received at the main sump and then pumped to the cyclone where excess fines are removed. These fines and most of the process water leave the top of the cyclone as overflow. This can be sent to a settlement pond or to water recycling / management systems such as a Matec thickener and subsequent filter press.

Washed sand product is discharged from the bottom of the cyclone, into a feed-box which then distributes the material evenly across the integrated dewatering screen. The dewatering screen is a low amplitude high frequency unit, always sitting at a slight incline, adjustable to suit the application. The motion of the screen encourages sand particles to move apart from each other, allowing residual water to drain through the sand bed and the dewatering screen back into the main sump below (thereby held within the process loop). Dewatered sand is discharged from the front of the unit, via a rubber lined chute.

Properly specified cyclone-based systems are also much better that conventional washing systems at dealing with variable fines-content materials. Small to medium fluctuations will have no negative effect on the output sand quality.

7.3.3 Sandtec: 'Standard' and UFR

Sandtec is Matec's hydrocyclone based washing unit, integrating a material reception sump, slurry pump, cyclone(s) and dewatering screen in a single, compact and highly versatile machine. As described in the preceding sections cyclone-based sand washing units offer the greatest balance of performance and efficiency and if properly specified will accommodate variable feeds much better than alternative technologies. This inherent efficiency makes them the most cost-effective solution in the medium to long term.

Sandtec units are specified according to two key factors:

1. Required tph (either feed rate or production rate). On occasion the customer will present with a given slurry flow that must be accommodated. For ease of reference, we therefore indicate both maximum slurry flow and maximum solids feed capability in our technical materials.
2. Input PSD and target product PSD, including the cut-point to be considered

With the tph and cut point considered we then look at the required slurry flow through the machine to achieve the desired results; this dictates the total water demand. Correctly estimating this is important as it will be used in the correct specification not only of the Sandtec but also of any additional downstream units such as a Matec thickener.

Sandtec water demand is calculated according to the following two factors:

1. Ensuring the correct solid/liquid concentration for efficient operation of the sand slurry pump
2. Volume of water required for efficient cyclone operation; calculated based on the tph solids to be removed in the overflow (the correct concentration of solids here also has an important effect on the efficiency of a downstream thickener and polyelectrolyte consumption).

When proposing a system Matec will indicate both the total water volume in circuit and the necessary make-up water. The latter is the water which should be topped up to the system to allow for water losses in stockpiles and tailings.

Sandtec's virtually limitless configuration possibilities mean that we can offer a solution for virtually every requirement with the two main priorities being sand washing i.e., removal of excess fines which we can consider as 'Standard' sand washing, and Ultra-Fines Recovery (UFR). In the latter case the objective is to capture as much material as possible from a slurry flow.

The fines separation point achieved in a Sandtec unit is mainly dependent on the size and number of cyclones specified. The general rule is that a high number of small cyclones will give a lower cut-point than a lesser number of larger cyclones. For example, an application where one 650mm cyclone would achieve a 75µm (200#) cut point might see an 'Ultra-Fines Recovery' 40µm (400) cut point achieved if using 6 nos. 200mm cyclones. Cyclone performance is determined by the capacity throughput, the induction point, the internal characteristics (such as the vortex finder size and shape), the outlet apex and of course, their overall diameter and length. Matec's technical team consider and adapt these aspects in the design and build of each project, allowing adequate scope for variability within the material wherever possible.

The majority of Matec Sandtec systems use reclined cyclones but some will be in vertical configuration. The difference on this configuration is sometimes raised by customers or competitors as a point of differentiation. Whilst gravity does have a part to play there are enough other factors governing particle behaviour to make the difference a very minor point. There is enough time for material within the cyclone and enough differentiation through pressure, centrifugal forces, and frictional pressure when material approaches the side walls to give the performance targeted, so in real applications there is no performance difference versus a vertical cyclone.

That brings us to the question of 'why do it?'. From a mechanical engineering / design perspective it is entirely logical to slightly recline the cyclone(s) where practical. Less support structure required, easier (and reduced) pipework to manage, more compact arrangement.

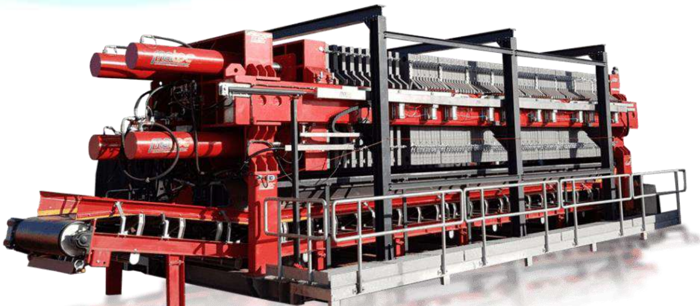
Whilst cyclones are a defining characteristic of the Sandtec they are just one element. As we have seen, the machine also integrates the necessary pump and dewatering screen. The pump selected is a Warman centrifugal model specifically designed for abrasive slurry applications, with the model and power specified according to the tph and flow volume to be handled. Matec always calculate water balances within the pump's optimal operational slurry density parameters.
The dewatering screen integrated within the Sandtec is a highly efficient and robust unit. There are several factors to consider when comparing dewatering screens. Area is of course one aspect but it is not necessarily the main driver of capacity and performance. By its nature, a dewatering screen must impart as much motive energy as possible to the sand bed traveling along it. Static sand particles will not allow water to filtrate through the screen: so maximum dewatering demands maximum motivation of the sand particles. An effective dewatering screen must therefore have an ideal blend of high energy (power), lightweight construction, rigidity, vibration isolation (it's no good having high power on the screen if a large percentage of the energy is then lost to the supporting structure). Next is the screen's motion. This should be linear, low amplitude, high frequency. Matec use 2 nos. offset vibrating motors mounted on an extremely robust (finite stress tested) bridge. The bridge must accommodate and transmit all the momentum from the motors to the loaded screen and do so for the life of the unit. It's therefore no surprise that the bridge is often the weak point in lower quality dewatering screens, particularly in high capacity applications. Matec's dewatering screen design is a perfect example of form following function: high kW for the given capacity, a stable and robust bridge, rigid and lightweight construction, with the ability to accept different screen media depending upon project requirements and customer preferences.

Where variable material is likely to be encountered, we recommend selecting the optional VFD (inverter) for the pump motor. This allows the operator to make instant adjustments to machine performance without needing to swap out belts and pulleys. We also advise holding spare apexes in stock as these are important for cyclone efficiency and should be inspected and replaced when their aperture exceeds the maximum advised diameter. Apex replacement is an extremely easy operation and replacement units are low cost.

7.2.4 Water Management: Completing the Circuit

Given Matec's clear experience in processing wash water it is worth looking at this aspect a little more closely, particularly given how fundamental water management is to many operators. It is fair to note that for many applications the water treatment phase is the most important aspect; without efficient water and tailings management the whole system will be unable to perform correctly. We can see note key stages in handling the water leaving a washing system. In most cases this is tailings water carrying 'waste' fines such as silt / clays. On occasion this may also be a commercially viable product, perhaps even the main product. The process is however reasonably similar across applications.

Stage one starts with the addition of a flocculant agent (polyelectrolyte) to the water. This is achieved via Matec's Bifloc dosing station, in many projects specified with our Doson system to offer a performance feedback loop, ensuring that the correct amount of polyelectrolyte is used and accommodating fluctuations in the feed material. Once mixed into the wastewater flow this settling agent rapidly encourages suspended solids to bond together into 'flocs'. By holding the water in an appropriately specified thickener, these flocs quickly settle towards the bottom of the tank, allowing clean reusable water to be immediately returned to the washing circuit. Matec is one of the few, perhaps only, major manufacturers offering a complete range of both horizontal and vertical format thickeners. Matec's technical team consult with each customer to find the best solution for their needs, whether the aim is to pump sludge a significant distance or perhaps to pass it directly to a filter press, whether there are specific layout or height restrictions on site. Underflow from the thickener, in the form of a thick sludge can then either be sent to a holding pit for storage or it can be sent to the *second stage* of management, a filter press, thereby completing the circuit. The filter press reduces the thick sludge product of the thickener to a virtually dry (typically >80 dry solids by weight)



Matec Filter Press

and highly compact form, completely removing the need for settlement ponds and reducing the need for make-up water to an absolute minimum. This filter cake can be used as a lining or capping material. In some cases, the filter cake may be the targeted main product or at least a high value material in its own right; this depends completely on the application and the materials involved.

Not surprisingly, given Matec's long and varied experience in filter press manufacture, our systems offer a number of unique features which directly deliver performance gains for their owner. One example is our TT2 rapid plate opening design which significantly reduces cycle time, thereby allowing a smaller volume Matec unit to outperform (and be more cost effective than) competitor offerings requiring longer cycles. Matec's virtually unique ability to feed filter presses at 21 bar and in some cases even higher is a further significant advantage. This aids processing of even the most difficult materials with a relatively standard specification machine, where other suppliers may need to rely on the additional complexity and cost of membrane plate systems or with the addition of further chemical aids.

7.3 Focus on C&D – differences vs 'standard' aggregate processes

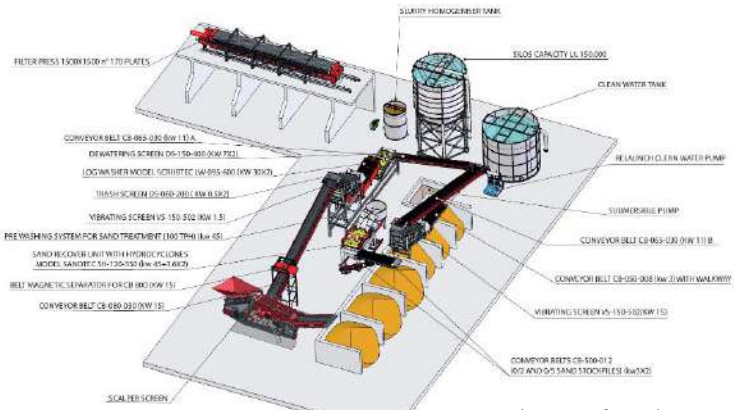
Construction, demolition, and excavation waste recycling is a growing sector in many markets. The U.K. was one of the first countries to become very active in this field and Matec have been active within its evolution there from the early stages, particularly within the fines and water management aspects which can present challenges specific to this segment. This experience has been invaluable in the development of our systems and processes.

C&DW materials can be highly variable, often presenting a broad range of contaminants including but certainly not limited to metals, paper, plastic, polystyrene, wood, grass and other organics.

Traditional recycling systems were dry operations composed of (most often mobile) crushing and screening equipment. Such systems offer good capacity capability, but they cannot offer high quality in-spec products compared to the potential production from a well-designed washing system. Furthermore, they inevitably create a significantly higher percentage of waste as they have no means to generate commercial quality sand fractions. This means that the minus 5mm (in some cases even the minus 20mm) is often just reject material. By contrast, a washing system can not only recover material to 75µm, it can do it to a quality standard which gives the products commercial value.

Mobility, plant footprint and availability of water were previously considered to be barriers to washing operations for recycled materials. With the highly modular integrated and compact systems developed by Matec, and of course with our advanced water recycling capabilities, efficient washing solutions are now within reach of many more operators.

In considering what makes a recycling plant configuration different to a 'typical' aggregate or mining one we need to come back to the contaminants to be addressed. Metals can be readily managed by appropriately placed magnets to deal with ferrous materials and eddy currents in the case of non-ferrous. Soils and sticky materials can be addressed with the Scrubtec logwasher which has been purpose designed for such feeds. As described in the section on Scrubtec, this unit also has the advantage of floating off liberated lightweight material such as the paper, plastic etc. often present in a recycled source material. As with any process, we want to recover as much commercially viable material as possible so we don't reject the entire Scrubtec overflow; rather we pass it to a dewatering screen which allows us to separate the 'trash' but retain water and fine sand particles within our process. These will either pass to a Sandtec or an Aggretec depending on the overall configuration; thereby being recovered with the main sand or 2nd sand product.



Example Matec C&DWR layout

It's worth noting at this point that many C&D systems are specified to generate two sand grades. One will be the higher quality target grade, often for use in non-structural concrete, for example traffic furniture (bollards etc.). The finer, lower grade sand is more likely to be used for pipe / cable bedding and will contain a higher percentage of recovered fines and contaminants, within the customer's target parameters.