TECHNOLOGIES FOR CONSTRUCTION ANDEMOLITION WASTE RECYCLING WITHIN BUILDING SECTOR

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ABSTRACT

In this paper we are presenting a study Technologies For Construction Andemolition Waste Recycling Within Building Sector. Only 11% of this waste was high quality recycled. In this chapter the sub-question "How can construction and demolition waste be recycled within the construction sector?" will be answered. By studying the re-use and recycling options of C&D waste within the building sector, insights in whether technologies and processes are available to increase the share of recycled materials in the sector are available. This chapter reads as follows: first the method of research for this part of the study is deliberated. In more information on waste sorting is given, since sorting is a vital part of high quality recycling. Re-use options for C&D waste are explained, followed by recycling .The re-use and recycling options are compared with each other.

Keyword : - *Sector, Technology, Recycle, Building, C&D etc.*

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1. INTRODUCTION

In order to get insights into which technologies are available for recycling within the construction sector, a literature study was conducted. This information was supplemented with information retrieved from experts and already executed projects to see which best practices already have been conducted. In the MFA, re-use was not included in the system. For the optimal technologies re-use is taken into account, since re-use is higher on the ladder of Lansink than recycling (see table 4.2).Only the largest waste streams are included in this literature study. The Pareto principle, also known asthe 80-20 rule, implies that about 80% of the effects are a result of 20% of the causes (Koch, 2008). Therefore, we focus on the group of materials responsible for the major part of the waste generated in the C&D. The MFA in shows that stony material, metals and wood are accountable for 83% of the total C&D waste generated in 2012 in the Netherlands. Improvements in the recycling and re-use rate of these materials will consequently have a large influence of the total C&D waste treatment. Even though sorting residue and mixed materials are large C&D waste streams, together 14% of the total, they are not included in the recycling and re-use chapter. These streams contain diverse materials, e.g. wood, paper, plastics, which – in general – will be incinerated with energy recovery as end treatment. Reducing these waste streams will be more effective than recycle them. In order to stress the importance of decreasing these waste streams.

Of the total Solid Waste generated in India, approximately 25% isresidue from coal combustion. These residues include fly ash, bottom ash and boiler slag.The amount of CCR (coal combustion residue) released by factories and thermal power plants has been increasing throughout the world, and their disposal has become a serious problem due to the large land requirement. The best way to reduce ever increasing land acquisition problem due to unabated CCR generation is to utilize CCR after converting it into a non-hazardous material. CCR can be used economically as construction materials, structural fill materials, etc.

2. SORTING

Sorting of waste materials is a crucial step in recycling. Waste materials need to be clean in order to be suitable for inclusion in the production of (building) products. By separating a larger number of different materials on-site, the amount of rubble and mixed materials will theoretically decrease, as is shown in figure 5.1 (DDC, 2003). Separation close to the source will prevent the waste being mixed with other wastes, and increases the amount of materials suitable for recycling (Edge Environment, 2011; Del Río Merino et al.,2010; Poon et al., 2001). As included in the Building Regulation “Bouwbesluit” of 2012 (Rijksoverheid, 2011) at least the following fractions of demolition waste need to be separated on-site when they arise in volume larger than 1 m3: dangerous materials in that are noted of the LoW (always, regardless the amount), stony material, gypsum based material, bitumen and tar roofing, 26 asphalt, roof gravel. In case there is an approved reason, a request for separation of the waste on another location is possible. According to M. Lamers of Baetsen BV, an off-site sorting company (Personal communication, 28 February 2013), the following material is preferred to be separated on-site: Scrap, ferrous and nonferrous metals, cables, asbestos, gypsum, AAC, rubble, wood A, B, and C quality, glass, and bitumen roof material. Furthermore, separation of the demolition waste is easier in case a building is designed to be taken apart at the end of its life. Therefore in the design phase of the building Deconstruction should be considered (Edge Environment, 2011).

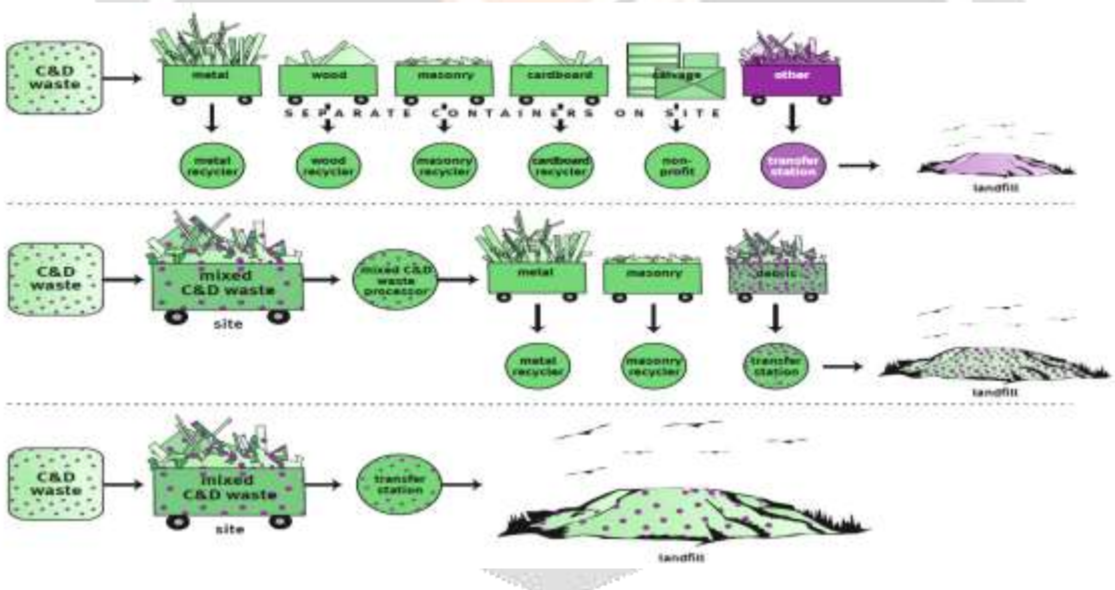

Figure 5.1: Sorting of materials at different stages leads to different amounts of material (source: DDC, 2003). For the Netherlands, the landfill should be replaced by a waste incineration plant.

3. RECYCLING WITHIN BUILDING SECTOR

After re-use of building materials, recycling of the material within the building sector is preferred. The embodied energy of recycled products is, in general, lower than products made from virgin material. The 29 use of recycled materials in construction will decrease the embodied energy of the building. Using recycled materials for construction does not immediately have a positive influence on the use phase, e.g. energy efficiency of the building in the use phase.

- Bricks
- Sand-lime bricks
- Concrete
- Crushing, sifting, with or without washing

4. THERMAL TREATMENT OF CONCRETE RUBBLE

In order to completely close the concrete cycle, gravel, sand and dehydrated cement can be retrieved from concrete rubble (Mulder et al., 2007). Figure 5.7 shows the process for thermal separation of concrete. First, the concrete rubble is crushed into small pieces with a jaw crusher. After crushing, the material passes a magnet, which extracts the steel from the material stream. Next is a rotary kiln, in which the temperature rises to 700 °C, which thermally separates sand and gravel from other materials. Then, by a vibrating screen, coarse aggregate is separated from the material stream. By an air separator the fine aggregates are captured, leaving the cement stone at the end of the process. Whether the cement stone can be added in the production of Portland cement should be tested more thoroughly (Mulder 2007; Betoniek, 2011).

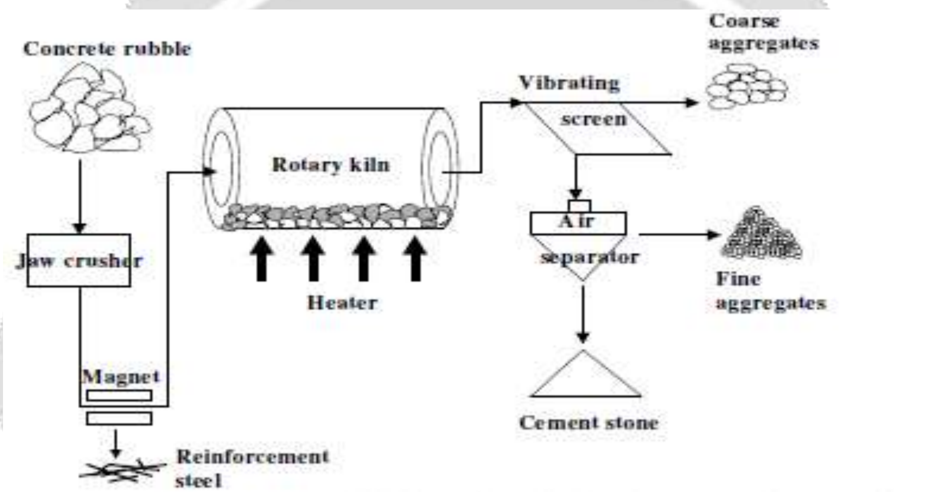

Figure 5.7: Preparing concrete rubble for recycling by thermal treatment (Source: Mulder et al., 2007).

5. C&D WASTE MATERIALS

For the major share of the materials, a recycling method within the sector is available.
To begin with, recycling or re-use of C&D waste materials do require good sorting both on and off-site. For material re-use, careful and selective demolition is required in order to keep the materials intact. The number of different waste streams sorted on-site should increase in order to supply clean material streams to building material producers or raw material producers. Re-use is valued higher in the Ladder of Lansink than recycling for environmental cause. The materials do, in general, only require minor adjustments for re-use, e.g. removing nails from wooden beams, manual separating mortar from bricks or resizing metal beams. To carry out these adjustments, extra labour is required, which makes re-use of materials expensive. The ceramic clay bricks prepared for reuse by thermal treatment requisite energy input. The 540 °C that need to be reached in the treatment is lower than the temperature needed for production of new ceramic clay bricks, 1100 °C, therefore re-use requires less energy than producing a new brick. This thermal treatment of bricks has, however, not yet been put into practice. Therefore, the feasibility of this method should be examined further. Metal recycling is practiced commonly, most of the benefits for environment and financial are acknowledged. Recycling slows depletion of natural resources, avoids mine waste products, and it decreases energy demand up to 90%, in respect to metal-from-ore production (Crundwell et al., 2011). Therefore, this sector is successful in recycling. It is, however, not known if the waste metal from the building sector is indeed being recycled into building material.

6. CONCLUSIONS

Further research and projects in this field are needed in order to show that cement paste can include in new cement. Woody material can have a long life by using the same material in different products. On the contrary, wood is a renewable resource, thus recycling of the material might not be necessary. In this study the circular economy is preferred, and that includes giving biomass back to nature or recycling the materials in their own cycle. More efforts in experiments and research, e.g. on wood or cement recycling, on improved recycling options are preferred for taking the next steps to the circular economy in the building industry. The coarse fraction of concrete aggregates can be easily implemented in production of concrete to substitute sand and gravel. The fine fraction that arises from crushing stones, which is 50% of the initial stone volume, has no recycling option within the building sector yet. In case more C&D stony material is used as aggregates in production of new stones, more fine material will be released. Thermal treatment of concrete rubble can separate cement paste from the fine fraction. However, this requires large amounts of heat and therefore implies a large CO2 emission. The smart crushing technology could be a better solution.

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