

Strategy for reuse of construction and demolition waste role of authorities

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1. Introduction

The production of construction and demolition waste (CDW) in the Netherlands is about 16 million tonnes each year. The same quantity can be used for a road base for a 250 km, six lane speedway, 20 meters wide and 2 meters thick. This is obviously an enormous amount for a small country like the Netherlands. The policy of the Dutch government aims at reuse of this CDW in its own cycle, at the highest possible level.

In 1980, the Dutch government published an order for waste treatment [1], which was called the Ladder of Lansink. This order was a fixed top-down approach, consisting of:

- Prevention
- Element reuse
- Material reuse
- Useful application
- Incineration with energy recovery
- Incineration
- Landfill.

Since 1980, more waste treatment options have been developed, therefore the Ladder of Lansink must be extended. This new order should not be a fixed top-down order, but should be flexible.

This new tool is called the Delft Ladder [2], and three new options were added:

- Prevention
- Construction reuse
- Element reuse
- Material reuse
- Useful application
- Immobilisation with useful application
- Immobilisation
- Incineration with energy recovery
- Incineration
- Landfill

Prevention tries to prevent the production of waste. This step must be taken before a building is demolished, in the design and building stage. This is called Design For Recycling (DFR). This can be done by using a dismantlable building system like LEGO is for children, or using recyclable or renewable materials which are easy to separate and can be used in their own material cycle. Construction reuse and element reuse can only be performed when the elements are suitable for deconstruction, for example prefabricated concrete elements. The current reuse of the stony fraction of building demolition waste in the road building industry is a way of material reuse. Recycling of materials can be preferred, which is for example the use of secondary concrete aggregate.

In this state of the art most commonly used dismantling-, demolition-, crushing- and separation techniques are described. In the chapter of demolition techniques a few techniques from other disciplines like techniques used for dismantling nuclear power plants have been added. These techniques could be used for dismantling buildings, which were never designed for dismantling into reusable elements.

2. Current situation

2.1 Role of the government

2.1.1 Introduction

Prevention and reuse are unlikely to grow if this is purely left to market forces. Hence, the government aims to direct the CDW market through legislation and other forms of regulation. The primary role of the government in this regard to set the constraints and take care of related policies. The nature of the Implementation Plan for Demolition and Construction Wastes is such that the objectives set by it are compatible with the market conditions wherever possible, within the confines set by government for the disposal of CDW.

There is a range of instruments available to the authorities to steer the CDW quality and quantity. The main government measures in the Netherlands will be discussed in this chapter so that we can analyse the resulting problems and how high level reuse can be promoted through legislation and other regulation. These measures include the Landfill Ban, Provincial Environmental Ordinances and the Building Materials Decree.

2.1.2 Demolition and Construction Wastes Landfill Ban

The Demolition and Construction Wastes Landfill Ban is an important measure to promote waste reuse. It prohibits, *inter alia*, the landfilling of reusable or burnable CDW and the use of unprocessed CDW.

One of the objectives of this ban is to promote the separation of CDW into component streams which are transported to processing plants rather than going outside the construction industry cycle. The landfill ban applies not only to reusable CDW but also to the residues from CDW processing (sorting and crushing). These residues, such as pre-crusher fines, often contain significant volumes of reusable material.

As a result of the landfill ban these residues are taken to sorting plants where they are separated into fractions. This often results in a significant further reduction in the volume of waste to be land-filled.

Before the introduction of the landfill ban, on 1 April 1997, landfill operators were permitted to

accept CDW without charging for it (no 'gate fees'). In practice this applied to clean rubble which could be used without further processing as foundation material for roads, etc. Only the Provinces could discourage the landfilling of CDW by regulating landfill rates and through the licences governing the design of the landfills. The introduction of the landfill ban means that CDW processing companies no longer have to compete with the relatively low landfilling charges.

The ban also means that the capacity of the waste incineration plants is used. Despite the environmental levy introduced in 1993, non-reusable burnable CDW was often landfilled as the landfilling charges were lower than the incineration charges.

The effective enforcement of the Landfill Ban requires certification of the sorting plants. As of the date of introduction of the Landfill Ban, landfill operators may only accept residues from certified companies.

These sorting operators can apply the landfill mark to materials to be landfilled if the residues contain no more than 12% of reusable materials. The costs of landfilling is 63,50 euro per ton, which is the reason to reduce the amount to be landfilled as much as possible. However, differences in enforcement between the Provinces have been found to complicate the effective enforcement of the Landfill Ban.

Demolition contractors who separate CDW at source are faced with the problem that they have to take the separated, non-reusable material to a sorting plant to get the landfill mark before they can transport the material to a landfill site. This imposes significant additional costs on them. In certain cases, these costs could make at-source separation less attractive. Demolition contractors should also be eligible for certificates to take non-reusable materials directly to landfill sites. Such a certificate could be included in a Demolition Process Certificate.

The Landfill Ban is an important instrument to increase the reuse rate and to decrease the amount of material or residue that needs to be landfilled. It also promotes improvement in the quality of material for reuse through the application of more sophisticated separation and cleaning technology. Hence, it not only increases the reuse rate but also significantly expands the options for high level reuse.

Further to the Asbestos Removal Decree, a certified company has to remove any asbestos present in the building before it is demolished. This will often require an asbestos analysis by a certified company. When the demolition wastes are delivered to a processing company it is again checked if they contain any asbestos. This asbestos management system ensures that the CDW to be processed does not contain unacceptable asbestos concentrations.

2.1.3 Provincial Environmental Ordinances

Waste disposal is primarily organised at the provincial level. Central government competency is decentralised to the provincial authorities. They can include regulations in their Provincial Environmental Ordinances (PEO) to implement their Provincial Environmental Policy Plans. The Provinces can pursue environmental policies which are stricter than the general environmental

policies, within the constraints imposed by the general quality requirements laid down in Orders in Council and other regulations.

The twelve Provinces in the Netherlands regulate the disposal of commercial wastes (trade wastes) through their Provincial Environmental Ordinances. By requiring notification of commercial waste disposals, the Provinces intend to obtain more information about the waste streams and to monitor disposal and processing. These ordinances require waste collection and processing companies to present quarterly reports to the province on the waste volumes they have received. Commercial wastes may not be transported between provinces, unless an exemption is obtained. In this way, the provinces want to prevent unnecessary waste transport and they also want to ensure that the capacity of the processing plants and landfill sites (created at great cost) in their provinces is used. Wastes on the so called 'Green List' for non dangerous wastes are not subject to this prohibition. Stony wastes are covered by this exemption, but only if the wastes are actually reused.

Provincial authorities have two clearly overlapping roles in this area. Firstly, as policy makers and regulators and secondly, as landfill operators and competitors of private industry. For example, in North Holland, the incineration charges are maintained at a very low level to offset the overcapacity created by the rapid increase in capacity.

Provincial authorities can direct waste streams through the environmental ordinances. In this context, they are only be guided by financial considerations but also promote high level reuse of wastes. They support the policies of the national government in enforcing their ordinances. The enforcement of the ordinances should be consistent between provincial authorities.

2.1.4 Building Materials Decree

The application of secondary materials should always be accompanied by an assessment of the long-term environmental impact of the introduction of these materials onto or into the soil. The Building Materials (Soil and Surface Waters Protection) Decree was introduced to do justice to the sometimes conflicting interests of the greatest possible reuse and the greatest possible protection of the soil and water.

The Building Materials Decree introduced regulations on the use of building materials: when they are placed they may not be mixed with the soil already present on site, it should be possible to remove them, and the materials must be removed when the structure is demolished.

The Decree introduced two categories of materials. Category 1 building materials fully meet the requirements and may be used without isolation. Category 2 building materials only meet the requirements if they are isolated and are also subject to further requirements. These requirements (standards) were set on the basis of the maximum acceptable soil contamination due to the leaching of building materials. If there are no leaching tests of sufficient accuracy for building materials, then their organic compound composition is considered.

Hence, the Building Materials Decree establishes a link between the emissions from a building material and the resulting soil contamination (immission). When determining the leachability of

building materials a distinction is made between shaped (e.g. bricks and blocks) and unshaped (loose) materials. A material is shaped if the volume of a unit is greater than 50 cm³ and has a strength exceeding 2 N/mm².

Some building materials obtained from secondary materials arising in the construction industry cycle, such as crushed asphalt aggregate, crushed concrete aggregate, mixed crushed aggregate, crusher fines and washed crushed brickwork aggregate are partly classified as Category 1 materials. Pre-crusher fines and undefined CDW are generally Category 2 materials. This is because CDW may be contaminated with organic compounds. Hence, some of the waste cannot be reused (particularly as unshaped material) or requires sorting and/or processing.

The Building Materials Decree provides sufficient options for the use of unshaped building materials derived from secondary materials from the construction industry cycle. Secondary materials may also be used in shaped building products, for example, the replacement of gravel in concrete by recycled aggregate.

Together with the Landfill Ban, the quality requirements introduced with the Building Materials Decree have improved the acceptance and processing of CDW to a great extent: two important conditions for high level reuse.

2.2 *Role of the market*

Apart from the policy of the Dutch government, there are demands from the market. Especially from the road building industry which needed the secondary materials (asphalt, concrete and mixed granulates) for their constructions. Concrete and mixed granulates proved to be a good alternative for the construction of road basements, asphalt could be reused in new asphalt. The availability of these materials was even cost effective.

The building and constructing industry researched the use of pulverised fuel ash, or simply fly ash, and granulated blast furnace slag as an aggregate in cement and concrete. The fly ash is a pozzolanic material, which is collected from the exhaust gases upon combusting of powder coal in power plants. Granulated blast furnace slag, a by-product from the production of iron and steel, is a (latent) hydraulic material which may react slowly by itself to form cementitious compounds [3]. Both materials are primarily used because, when used in Portland cements at the right dosages give the special qualities which are used in special construction environments. Therefore, all the fly ashes and granulated blast furnace slags, produced in the Netherlands, are used right now in the cement producing industry.

2.3 *Amounts*

The use of secondary materials in the building and constructing industry proved to have an enormous effect on the total amount of waste. The production of these construction and demolition wastes is, as mentioned, about 16 million tonnes per year [5]. It is the second largest waste-stream in the Netherlands (after dredge sludge, 55 million tonnes, and before municipal wastes, 7 million tonnes). The use of secondary materials, produced from building and constructing waste is nowadays about 90%, 14,6 million tonnes. 1,2 million tonnes is being landfilled and 0,2 million tonnes is incinerated. The use of wastes from other industries in the building and constructing industry is

about 11,5 million tonnes. So the total amount of wastes used in this industry is about 25 million tonnes each year, this is about 18% of the total need for raw materials in this industry. 25 million tonnes, that is 25 football fields covered with waste with a height of 30 meters, each year. So the building and constructing industry uses more waste than it landfills or incinerates. The amount of waste that is landfilled from all industries is reduced each year. In 1999 about 5,5 million tonnes of waste is being landfilled, this must be reduced to 2,0 million tonnes in 2010, while in 1990 14 million tonnes is being landfilled. In 1976 there were about one thousand landfill sites, in 1999 only 38 landfill sites were still in use. Due to the use of secondary materials, the need for raw materials is lower. Therefore the scenic deterioration is less.

2.4 Concluding remarks and recommendations

Not all the effects of reusing secondary materials are positive. The crushing of the stony fraction takes a lot of energy. Sometimes the use of secondary materials needs introduction of additional materials. For the use of concrete or mixed aggregates in concrete, more cement is required in order to reach the same quality. The properties of products with secondary materials is an important point. Not only the strength and the stiffness of the material must be (at least) the same as that of the primary material, also the leaching (Dutch Building Decree) and radiation must be restricted to narrow limits. The use of secondary aggregates in road construction gives problems when it contains only a little bit of gypsum, because the sulphate leaching is rising extremely. Also radiation in the inner climate is increased by using these secondary materials as an aggregate in concrete. Despite the problems the Dutch building industry has reached a higher level of recycling the last few years. But the recycling of building demolition debris is totally based on the road building industry, which can be risky. By promoting the higher levels of recycling according to the Delft ladder, the waste problems can really be solved.

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