STIMULATING THE USE OF SECONDARY MATERIALS IN THE CONSTRUCTION INDUSTRY: THE ROLE OF CERTIFICATION

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ABSTRACT: *Introduction of secondary materials in the construction industry is quite difficult and has not always been successful, even when they satisfy all necessary product demands and environmental (leaching) conditions. Besides the financial and commercial aspects the main problem is convincing the user or customer that the secondary material is a safe and reliable alternative for primary materials. The best way to deal with this problem is by certification of the secondary material. Optimal results can be expected when authorities and both suppliers and users of the new type of material closely collaborate. This can be achieved by mutual consulting in regard to technical aspects and their demands concerning the product. Collaboration between suppliers enables joint investments in order to obtain certification and to enhance the knowledge about their product. This collaboration will also stimulate the consideration that the supplier is a good and reliable trading partner for the user.*

KEY WORDS: secondary materials, building materials, construction industry, introduction, certification

INTRODUCTION

In the period from 1960 till 1980 the production of waste materials increased dramatically in the Netherlands. A large part was dumped at waste disposal sites without adequate soil protection. Another part was used in embankments or other construction works, without proper treatment and in later years this often caused soil and surface water pollution.

In the construction industry large amounts of materials are used which are generally from the environment. Examples are soil, clay, sand and rocks. Alteration of landscape (digging and dredging) also produces large amounts of material that has to be dealt with. Finally, used constructions are demolished, producing large amounts of waste. The destiny of all these materials may be reuse, disposal or burning. Burning or treating waste will result in new and other waste products.

The Netherlands is a densely populated country in which space is limited and soil is precious. Therefore all activities that may have a negative impact on space and soil such as dumping and digging should be limited and controlled. Soil contamination has to be prevented, because the soil often will be required for new constructions and possible cleaning is expensive. These considerations have led to a policy to achieve a substantial decrease in the amount of waste that has to be disposed as well as preventing that the treatment, re-use or disposal of the waste has negative effects on the environment, especially on the soil. In order to promote re-use of materials and still protect soil and surface water, the Building Materials Decree (BMD) was introduced in the Netherlands, in which composition and leaching of primary and secondary construction materials is regulated (Ministry of VROM, 1995 and 1998).

Primary materials are raw materials extracted from the natural environment and used in a production process for the first time. Secondary materials are materials that are released during industrial processes and used again in a new production process. Replacing primary materials with secondary materials could save natural resources and contribute to a sustainable society in which material life cycles as much as possible. Both the Dutch government and Dutch industry stimulate this policy of sustainable development and executed technical research and example projects in order to find new treatment techniques and ways of usage of secondary materials.

USING SECONDARY MATERIALS AS BUILDING MATERIAL

As a result of the environmental policy and the increasing availability of waste treatment techniques, the construction industry is confronted with the availability of secondary materials that can be used as an alternative for traditional primary materials. The interested parties on this market may act both as supplier (e.g. demolisher or dredger) and as the user (constructor) of the new building material.

However, even when the secondary material satisfied all necessary product demands and leaching conditions, this has not always been sufficient for a successful market introduction. All aspects that could influence a successful introduction on the market can be categorized into three items:

- policy (governmental and industrial)
- material properties (physical and environmental)
- commerce (financial and image related)

The requirements for a successful introduction of secondary materials in the construction industry will be explained below based on these three aspects.

Policy

Recently in the Netherlands the Building Materials Decree (BMD) was introduced, in which composition and leaching of construction materials is regulated (Ministry of VROM, 1995 and 1998). It provides norms and conditions that should be obeyed when soil, immobilisates or construction materials are applied in the outside environment. The decree is based on the laws for protection of both soil and surface water. Thus, the quality criteria given in this decree are all set from a point of view of soil and water protection. The BMD prescribes the maximum allowed concentration of organic substances in and/or the leaching of inorganic substances from construction materials, independent of their origin, in other words no distinction is made between primary, secondary, or waste materials. It also prescribes how products should be certified and how their application should be controlled.

There is a difference between the roles of government and industry concerning the introduction of secondary materials (Van Eijk, 2001). When the new material is financially attractive, its introduction and application will be developed automatically and can be stimulated by the industry itself. When it is not financially attractive the supplier depends on the environmental policy of its customer but even then this is not always sufficient for a successful market implementation. In that case governmental influence may be necessary in order to enforce a market implementation. In order to reach this goal the authorities have several possibilities:

- making the dumping of the (waste) material costly (or even not allowed at all)
- prohibiting or introducing levies on the traditional primary material.

Authorities itself can be in charge of the construction of civil objects, and in such case they play the role of customer. In that role they can demand the use of secondary materials in the civil object. Authorities can also initiate and be in charge of trial projects in which secondary materials are to be used.

Material properties

Solidification/stabilization (S/S) techniques may be required in order to render a raw secondary material into an immobilisate that can be used safely as a construction material. The treatment costs will then be compared with the costs that would need to be made when the material had to be transported and dumped. When S/S results in a product that is more expensive (taking account of treatment costs and avoided dumping costs), than its traditional alternative on the construction market its properties should be worth the extra price (Van Eijk, 2001). Otherwise the buyer will not consider it as a serious alternative. The extra environmental value is often not considered as a real extra value in a commercial market like the construction industry. Only physical material properties that differentiate it from the traditional material will be considered as real extra values. Such properties include a specific shape, colour or density.

A secondary material is also a low-cost alternative when its application saves time, when its raw material is more

easily available or when its processing is more straightforward compared to the traditional material.

In order to convince the buyer that the secondary material is an environmentally and technically safe product it is the task of the supplier to obtain the required knowledge about these properties (Van Eijk, 2001). This will clarify the possibilities and restrictions on its application. This knowledge of the product will also help in obtaining product certification.

Commerce

Introducing secondary materials on a commercial market like the construction industry is difficult (Van Eijk, 2001). The customer has to be convinced about the liability involved with the product as well as the supplier. A supplier of secondary materials will often have to deal with a negative image of his product because it is still related to waste. Solving these problems take a lot of effort and research. When the supplier is a small company, its limited knowledge, experience and financial possibilities make it difficult to do research, to set-up trial projects and to obtain certification.

ROLE OF CERTIFICATION

Introduction of secondary materials requires that all parties of interest will be satisfied. The government wants to minimize environmental effects when these materials are applied. The consumer will consider the secondary materials as a good alternative only when its quality is assured. It is also advantageous for the supplier when it is in a position to give his insurance to his product. All interests can be met by a clear and unambiguous certification system (Van Eijk, 2001). When the construction material is certified, the user will also be less worried about liability aspects during the service time of the material. Thus, certification gives both suppliers and consumers certainty about the quality of the material and therefore is considered to be an important step towards successful introduction of secondary materials.

During the set-up of the BMD the Dutch government has paid a lot of attention to the enforcement of the rules by the local authorities (Eikelboom, 1999). Therefore certification for building materials was introduced in the decree to improve effectiveness and efficiency of the enforcement. Certification is a means of ensuring products are in compliance with legal standards. All test methods have to be performed by accredited laboratories in order to get uniform results and to ensure proper interpretation of the test methods and a proper way of taking samples. The most extended type of certification is based on basic characterisation tests that have been chosen to give a general judgment. It can only be given by accredited certification institutes. A less expensive and less time consuming acceptance procedure results in an examination report for one specific stock of materials.

All tests required for certification are described in standard protocols, e.g. NEN norms. For organic substances only maximum concentration levels in the product have been defined (Ministry of VROM and others, 1999). For inorganic substances maximum immission values were defined as the maximum quantities that may disperse into the soil or surface water when released from the material. Release of inorganic materials is measured by means of some advanced release tests: a column test (NEN 7343, 1995) for granular materials and a diffusion test (NEN 7354, 1995) for moulded or monolithic materials. Formulae were developed to make a connection between the leaching results and the maximum immission values. These formulae deals with the type of work, the way the material is used in a work and possible isolation measures that can be taken.

When the material contains organic levels that succeed the maximum levels it is not applicable in any way. When immission of inorganic substances is below levels without the requirement of isolation the material is defined as a category-1 building material and may be applied without isolation measures. When immission levels can only be fulfilled when isolation measures are taken, the material is defined as a category-2 material. These types of materials have to be applied taking into account directives for isolation, conserving and controlling of the application. When the material cannot fulfill the immission demand, even with isolation, it is not applicable in its present form (and dump may be the only solution).

Roles of principal and designer

Because the principal gives the orders and because he finances and holds title in the work, he will be the party with

most participation, responsibilities and interests during the construction process (ministry of VROM, 2000). He will make the final decision on whether to use secondary materials or not and thus has the power to stimulate this use or constrain it. Designers can advise about the use of secondary materials and its consequences. This advising role of the designer will have most impact when the principal does not have much experience and knowledge on constructing. In some cases it is decided that the builders will play a more significant role during the construction process. This means that they will play an advising role during the designing process and communicate more directly with principal and designer. In that role they will have more participation in the choice for secondary materials. This can be advantageous when he has good experiences working with secondary materials.

Use of materials

Traditionally the specifications of a work contain the amounts and types of materials that will be used and the builders are not allowed to deviate from it. As an alternative the principal may choose to use specifications based on performance. This means that the specifications contain more general demands and the builder has more freedom in making choices in order to comply with the requested demands and performances. With this way of working the principal can set environmental demands, e.g. the use of a minimum amount of secondary materials. The Dutch government ordered the building of many road constructions and promised additional payments to the builders if they used secondary materials.

The builders will have to deal with proper application of building materials. For example they must obey the rules relating to isolation, control and monitoring when using category 2 building materials. Also, they must observe the rule governing removal, in other words they must use the material in a manner that allows it to be removed.

Information

The principal is responsible for the quality and environmental impact of the work they order to build and must take all necessary measures in order to fulfil these demands (ministry of VROM, 2000). The principals must record or have recorded all information on the chemical composition and leaching behaviour of building materials, which are covered by the BMD. He must keep this information available and is sometimes required to furnish the information beforehand to the empowered authority. He is also required to ensure that any rules governing use (e.g. isolation measures) are complied with. Therefore he will demand that suppliers, builders and sometimes even designers will show him this information. In order to prevent misunderstandings during the construction process, it may be necessary that the principal makes clear to the builders what rules are to be complied with and exactly what types of information they require for his duty of information (e.g. a recognised approval or a batch inspection). Thus, although the principal must provide the authorities with information, actually the suppliers or builders will supply the requisite information. This information will proof that batches of stony material or earth that will be delivered satisfy the quality requirements of the BMD.

COLLABORATION

Obtaining product knowledge, setting up the proper certification procedure and finally introducing a secondary material on the market is difficult, time consuming and expensive. In order to overcome these problems some parties of interest in the Netherlands decided to collaborate. Two examples will be given below.

Powder coal fly ash is the remaining product from the burning of powder coal in power plants. Both industry and government agreed that dumping of this material should be prevented. The Dutch coal power plants founded the Fly Ash Union, an institute that was given the task of implementing and sustaining sales of fly ash to the construction industry (Anonymous, 1997, Cornelissen and Jenners, 1998). The collaboration between the suppliers (coal power plants), customers (cement manufacturers and concrete companies) and government, led to financial advantages required for research and certification. A certification procedure was set up that fulfilled the demands of all parties of interest. As a result of this collaboration Dutch powder coal fly ash is now reused for 100 % and applied successfully in the cement and concrete industry. In the Table below the reuse percentages of other European countries are given, showing that the Netherlands is the only country where fly ash is reused for 100% (Cornelissen and Jenner, 1998). If this is due to certification is difficult to say, because availability of primary materials and space for dumping of waste

differs significantly from country to country. On the other hand, the Netherlands is the only country in the list, where the government and the construction industry closely collaborated and now exchange clear information and publications related to certification (ministry of VROM, 2000).

Table 1: Reuse of fly ash

Country	Percentage of produced fly ash that is reused
Netherlands	100
Germany	95
Belgium	95
United Kingdom	40

In the Netherlands the government allows the co-combustion of maximum 10% of secondary fuels (sludges, waste wood etc.) together with coal. A technical research program has revealed that the resulting fly ashes to be conforming to powder coal fly ash, enabling the reuse of these fly ashes as secondary material as well (Lamers et al. (2000)).

In 1998 a Center for Immobilization was founded in the Netherlands (see www.immobilisatie.nl). Members of this center include producers of immobilisates, waste disposers, research and knowledge institutes, governmental institutes and the cement industry. The main task of this center was performing an active and substantial contribution in canceling obstructions for application of secondary materials. The center combines knowledge and experience from industry and authorities and acts as discussion partner for all parties of interest. It gives information about technical and legislative possibilities and restrictions for applying secondary materials. It is also involved in research and setting up/improving legislation, certification procedures and tests.

CONCLUSION

For market introduction of secondary materials many problems need to be overcome. A successful market introduction depends heavily on certification and dealing with the interests of all involved parties. Best results can be expected when authorities, suppliers and users of the new material collaborate by consulting each other about technical aspects and their demands concerning the product. Collaboration between suppliers makes joint investments possible in order to obtain certification and enhance knowledge about their product. When certification procedures are set up in dialogue with all parties of interest, they will satisfy demands of both government and customer and be clear for the supplier(s). On the other hand, when the certification procedure and values are determined by governmental parties only, i.e. without any consulting, this can even result in procedures that are not supported by the involved users or that are impossible to comply with. In that case, certification can even result in a limitation of the application possibilities instead of an improvement.

In some cases it can be useful to establish an institute that is responsible for preparation and implementation of the sales of the secondary material. This institute will execute research, certification and contribute to a good image of the product.

Collaboration between suppliers will stimulate the idea that the supplier is a good and reliable trading partner for the user. When market introduction has been successful the same institute can take care of continuous delivery and quality of the material.

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