3rd International Conference
"Advanced Composite Materials Engineering"
COMAT 2010
27- 29 October 2010, Brasov, Romania

RECYCLABLE MATERIALS USED IN CONSTRUCTION OF STREET BARRIERS

[1] Gianina Ileana STAN*, [1] Ovidiu Mihai TERCIU, [1] Camelia CERBU, [1] Ioan CURTU
[1] "Transilvania" University of Braşov, Romania

Abstract: *In the past people used to repair and reuse what they could. The population was smaller and people living in less concentrated groups. On top of that, packaging materials were used which decompose easily and thus return materials in kind was much faster and easier. The industrial revolution allowed industrial-scale manufacture of packaging light-resistant, which maintain different foods in appropriate conditions for a long time. Another consequence of economic and industrial development occurrence is the occurrence of highways and with them, unfortunately, noise pollution, which is lately are all intense.*
Keywords: *reuse, conservation, recycling programs, highways, noise pollution*

1. INTRODUCTION

With the structural transformation, over the years, and components designed to complement the road infrastructure has been implemented and modified. Evolution is the benefit of mankind, but that is the tribute we need to pay? World's population has increased dramatically and continues to grow, while resources are becoming less accessible. In this way soon, we risk not to have raw materials from which to achieve the necessary products for everyday life.
Benefits of recycling are the conservation of natural resources and reduce storage space. However the collection, transport, recovery and final processing of materials requires additional energy, and most recycling programs are subsidized economy.
Street panels are produced in absorbing a wide range depending on their acoustic properties, finishes, materials, patents used, size, durability, reliability, low cost, etc..

2. TECHNICAL REQUIREMENTS

In the past people used to repair and reuse everything they could. Population was less and people lived in less concentrated groups. Besides this, the packaging materials used were readily decomposed and return such materials in kind were much faster and easier. The industrial revolution allowed industrial-scale manufacture of packaging, light-resistant, which maintain various foodstuffs under appropriate conditions for a long time. Another consequence of economic and industrial development is the appearance of highways, and with them, unfortunately, noise pollution, which is lately are ever more intense.
Many products are available which claim to be "environmentally friendly" by incorporating various recycled materials in their manufacture. Examples are: recycled plastics in supporting structures, waste materials from industrial processes in absorbers, sections of old tires as planters, domestic waste transformed into compost. There may be limitations in the suitability of recycled products. The use of mixed scrap and surplus may affect choice of color; eliminating contamination and reprocessing reclaimed materials will add to costs. It is important to establish whether the recycled product is comparable with new material and to ensure it will not tend to degrade more quickly.
The concept of ecological design is becoming more current, being developed even of international level, and applying these regulations, it is to the attention of many specialists in various fields.

2.1 Importance of noise barrier

The material, location, dimensions, and shapes of noise barriers can affect the acoustical performance.
Figure 1.1 is a simplified sketch showing what happens to road traffic noise when a noise barrier is placed between the source (vehicle) and receiver. The original straight line path from the source to the receiver is now interrupted by the noise barrier. Depending on the noise barrier material and surface treatment, a portion of the original noise energy is reflected or scattered back towards the source. The other portions are absorbed by the material of the noise barrier, transmitted through the noise barrier, or diffracted at the top edge of the noise barrier. However, the transmitted noise continues on to the receiver with a "loss" of acoustical energy (acoustical energy redirected and some converted into heat). The common logarithm of energy ratios of the noise in front of the barrier and behind the barrier, expressed in decibels (dB), is called the Transmission Loss (TL). The TL of a barrier depends on the barrier material, and the frequency spectrum of the noise source [2].

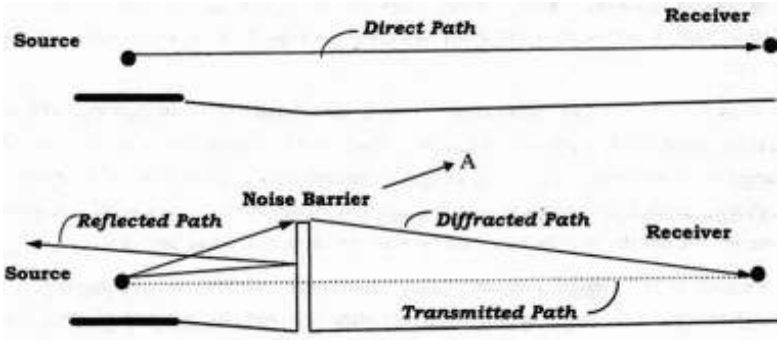

Figure 1. Alteration of Noise Paths by a Noise Barrier [2]

The transmitted noise is not the only noise from the source reaching the receiver. The straight line noise path from the source to the top of the barrier, originally destined in the direction of A without the barrier, now is diffracted downward towards the receiver (Figure 2.1.2). This process also results in a "loss" of acoustical energy.

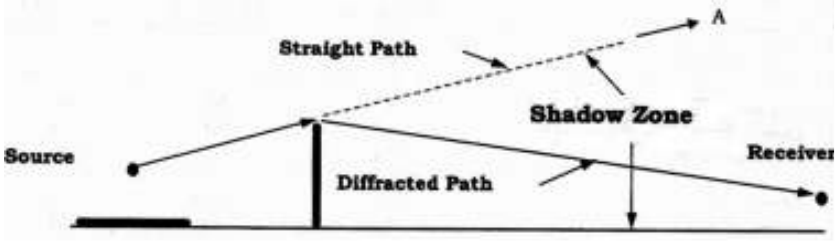

Figure 2. Barrier Diffraction [2]

The receiver is exposed to the transmitted and diffracted noise. Whereas the transmitted noise only depends on barrier material properties, the diffracted noise depends on the location, shape, and dimensions of the barriers [3].

2.2. Raw materials

By restraining traffic effectively and withstanding impact damage, the noise barriers provides for the safety and well-being of road users and construction workers alike, helps to keep traffic moving and has a neutral impact on vehicle noise. The most common materials in the manufacture of street soundproofing panels are metal, wood, ceramics, concrete, reinforced cement, glass laminated, polimetilacrilat, polycarbonate and plastic [7].
Construction sector (and perhaps especially, the construction of noise barrier) has an particularly impact on the environment through specific activities related to: design (design life cycle, production of construction materials, transport and release work, operation and maintenance, demolition and recycling, etc..

Plastics. Plastic was invented in 1980 by Alexander Parkes, being widely used in recent decades. Plastic is made from oil, gas and coal, at present there are about 40 types of plastics, each with a different chemical composition and properties. Products made of recycled plastic are cheaper manufacturing costs compared to

those made from raw materials. Recovery of plastic packaging is a big challenge, primarily due to the large number of PET (polyethylene - is a sophisticated material strength) used very effectively as a container for beverages. PET recycling is huge advantage, given the large number of bottles used which can be exploited at an acceptable cost. Plastic it is added on the road barriers in the composition of transparent panels that give them an increased noise protection and a special aesthetic [1, 8].

Figure 3. Recycling plastic and turning it in street barriers [1, 8, 10]

Metal doses. Doses are crushed, bale and shipped to central processing or recovery facilities. Recovery facilities, crushed cans are first heated to remove moisture and then loaded into a remolding furnace. Molten metal is turned into ingots which are then transferred to another processing unit and pulled the thin sheet. The sheets can be reused in industry for different utilities, depending on market demand. Thus, in the process of obtaining bullion, metal sheets that will significantly reduce the use of natural resources.
Street absorbing metal panels consist of two separate sheets phonon-insulating and soundproofing properties. Sheet metal corrosion are important protected by painting both internally and externally. Insulation material is generally composed of mineral fibers or fiber density polymer plastic, sealed with an impermeable tissue. Sheet metal exposed to the noise source has some openings, holes, generally micro - perforation, leading to increased noise absorption properties. If properly installed, these panels have high resistance to corrosion due to aggressive environmental factors, but have the disadvantage that have a high weight [1, 9].

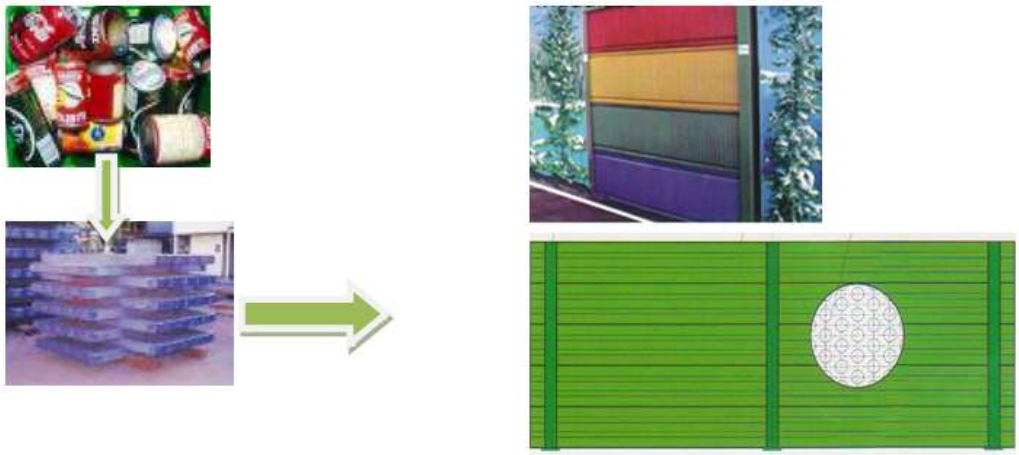

Figure 4. Recycling metal doses and conversion into street barriers [1, 11]

Glass. Glass containers manufacturers prefer to include fragments in raw material (sand, soda ash, limestone), because the oven temperature is reduced significantly. The glass how is not sorted by color, is acceptable for the manufacture of construction materials, even if contaminants such as ferrous metals and aluminum must be removed magnetically. The glass dust that cannot be used to manufacture other recipient, can be exploited through glass wool, material used in thermal and acoustic insulation. These panels generally consist structural

elements of steel and transparent plates. Incorporated material is transparent glass sheets laminated material having an optimal transparency, but also a greater sensitivity to scratches [1, 12].

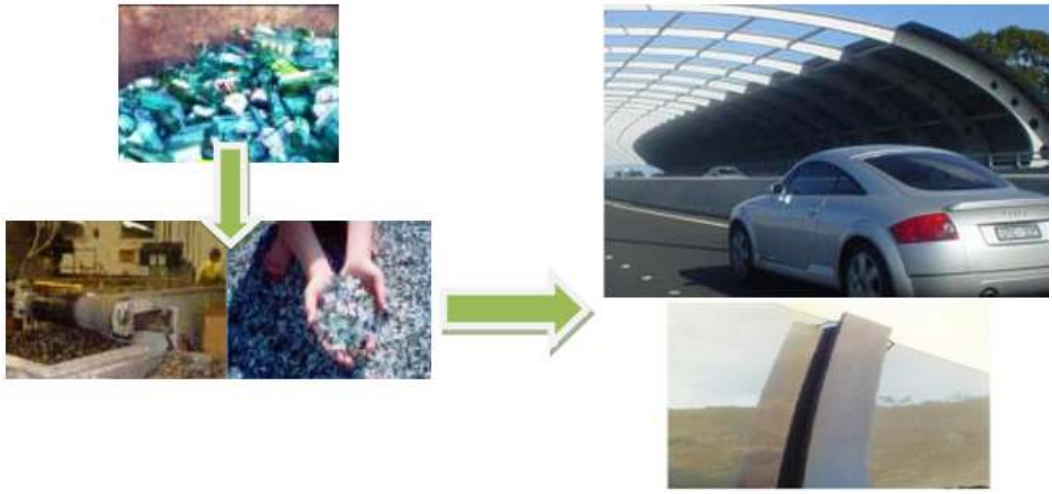

Figure 5. Glass recycling and turning them into street barriers [1, 8, 13]

Wood. It is relatively easy to do the recycling material recovered contained in untreated wood in the construction materials from wood or compost production rugs and rich in peat. In contrast, many wood furniture are composed of veneer boards or other similar materials derived from wood, solid wood furniture has become very rare. One of the possibilities for recovery of material recovered contained in chipboard furniture clean consists in detachment of wood chips by dissolving wood chips chain (resin). Wood chips can then be bonded to form new boards. Also, the quality of the boards decreases with each recycle; it must then add fresh chips each time in the production of plywood. These panels are composed of different frames, slats or blades to external wall, a deafening material, a full back wall - the front plate and sealing elements. The wood used is treated with salt to prevent damage caused by environmental factors. The back wall is made of slabs of wood embedded with at least 4 cm thick. Acoustic properties are significant because of these panels has a reflective component [1, 9, 14].

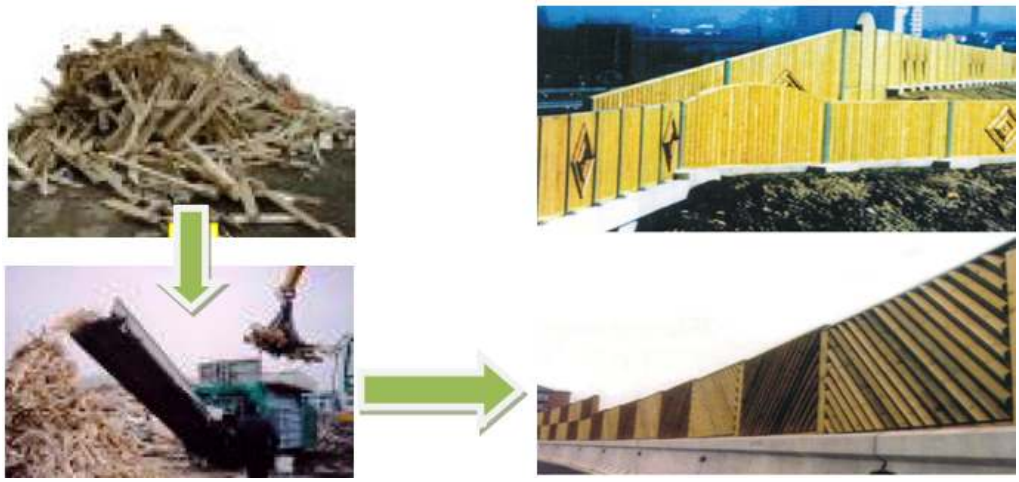

Figure 6. Wood recycling and processing of the street barriers [1, 9, 11]

Construction and demolition waste. . Construction and demolition waste are resulting from construction, renovation and demolition of buildings, streets repave projects, repair of bridges, cleaning associated with natural disasters. Street panels from concrete consist of a layer of reinforced concrete and concrete slabs, expanded clays, pumice, porous concrete, composite material wood - concrete. Pillars are made of steel or concrete, and panels are composed of modular panels generally a square shape with dimensions of 50 x 50 cm. These panels have a lifetime high even in a chemically aggressive environment. One of composite materials with the highest absorbing properties used in the construction of panels street is fiber-cement. In the

combinations concrete – wood, is important to choose the correct binder and cement dust grain to avoid decay and cracks appearing after several frosts and repeated thawing.

Figure 7. Recycling of construction and demolition in street barriers [1, 13]

Waste from gardens and parks. Composting is the process of manufacture the food waste from kitchen and yard are transformed into a compound rich of nutrients. By returning nutrients in soil, compost reduces the need for expensive chemical fertilizers. The main opportunities for recycling garden waste are to: compost production; landscape restoration; use as alternative fuel; use as intermediate cover material deposits. Waste from gardens and parks are generally accepted as the best quality materials to produce compost. A range of natural-looking bio-barriers has been developed which offers an alternative to earth mounds. This have the advantage that they do not require the space needed for a mound, in effect creating a living barrier on a narrow strip of land. As well as reducing land-take, this bio-barriers act as wildlife corridors creating habitats for small mammals and insects.

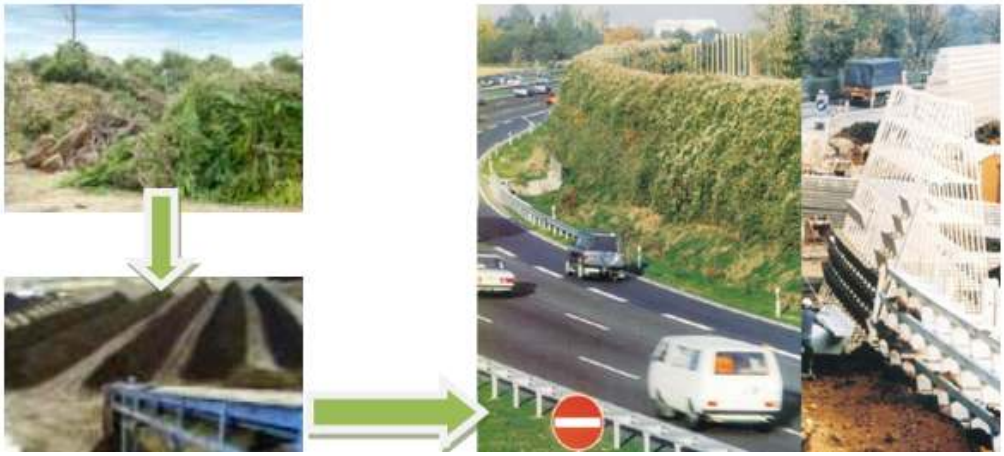

Figure 8. Recycling waste from gardens and parks in street barriers [1, 5]

3. CONCLUSIONS

A major goal as part of system engineering is designing the system and its components for recycling, reuse and cassation. From the perspective of maintenance, such an objective performance should result in minimum requirements for logistics resources required (e.g. spare parts / repair, testing equipment, software, personnel, building, data, etc.). When such resources are needed, it is recommended to be used and standardized commercial items. In essence, the same principles applied in designing reliability, maintainability and maintenance should be implemented here. Just like in "introductory phase of training and" life cycle of the system, attention should be paid to stage "scrapping and recycling".
Noise barriers should be designed so that they require minimal maintenance other than cleaning. Concrete or masonry walls require little or no maintenance during the desirable service life of 40 years, but transparent sections need frequent cleaning and might well need replacing during their service life. Careful design can prevent the need for on-site modifications or other damage during construction that might considerably reduce

the life of noise barriers. For example, hammering of panels for fitting into place could cause damage and should be prohibited. Therefore, design should be done carefully with due consideration of the practicability in construction. Plastic panels should incorporate resistance to the effects of ultra-violet light. Surfaces and joints should not include dirt or moisture traps or other details liable to cause rust staining. The effects of weathering on color and of rain-wash on accumulated surface grime should also be considered [2, 6].

ACKNOWLEDGEMENT

This work is supported by CNCSIS –UEFISCSU, project number PNII – IDEI 733 / 2008.

REFERENCES

[1] Benz Kotzen and Colin English Environmental Noise Barriers: A Guide to their Acoustic and Visual Design,E & FN Spon, London, Edition 2009.
[2] Bilitewski B., Hardtle G., Marek K., Weissbach A., Boeddicker H., "Waste Management", Springer Edition. 1997.
[3] Environmental Protection Department Screening: Structures and Building Designs against Transportation Noise in Hong Kong, Environmental Protection Department, Hong Kong, 2001.
[4] Highways Department: Final Report of the Noise Enclosure Lighting – Engineering Study, Highways Department, Hong Kong, 2002.
[5] Intergovernmental Panel on Climate Change, WGI Fourth Assessment Report. "Climate Change 2007: The Physical Science Basis: Summary for Policymakers," February 5th, 2007.
[6] McDougaU, F., White, P.: "Integrated solid waste management: a life cycle inventory" - Blackwell Science Edition 2001.
[7] MINISTERUL MEDIULUI SI GOSPODARIRII APELOR: "Metode si tehnologii de gestionare a deseurilor. Reciclarea deseurilor"; INSTITUTUL NATIONAL DE CERCETARE – DEZVOLTARE PENTRU PROTECTIA MEDIULUI – ICIM BUCURESTI,2006.
[8] STAN G.I., CURTU I.: "Tendencies in construction of sonar screens realized from lignocellulosic materials used for arterial highway" International Conference "WOOD SCIENCE AND ENGINEERING IN THE THIRD MILLENNIUM" - ICWSE 2009.
[9] STAN G.I., CURTU I.: "Aspects regarding fonoabsorbants properties of lignocellulosic materials customized to the screen for highways" International Conference "WOOD SCIENCE AND ENGINEERING IN THE THIRD MILLENNIUM" - ICWSE 2009.
[10] STAN G.I., CURTU I.: "Materiale reciclabile utilizate la constructia barierelor stradale", Proceedings of IV-th National Conference THE ACADEMICS DAYS OF Academy of Technical Science in Romania,Iasi, 2009.
[11] STAN G.I., CURTU I.: "Aspects of the influence of noise from the highways on animals in urban areas", Proceedings of IV-th National Conference THE ACADEMICS DAYS OF Academy of Technical Science in Romania, Iasi, 2009.
[12] The Highways Agency: Design Manual for Roads and Bridges, Volume 10, Environmental Design, Section 5, Environmental Barriers, Part 2, Environmental Barriers: Technical Requirements, HMSO, London, 1995.
[13] VIRANO, M, "Verso un modello di azienda pluriservizi", in VIRANO, M., SANTONASTASO, F., "Autostrade e territorio", Il Sole 24 ORE, Milano 1999.
[14] *** SITAV, "Presentazione della divisione bonifica acustica", Torino.