Innovative materials for cradle to cradle

Greenmatter

Concrete made with elephant grass, super-insulating glass, nanogel, bio-resins, plastics from recycled chewing gum, flexible films with solar cells, houses from paper, concrete made with bacteria.... What these materials have in common is that they all share sustainability one way or another.

Sustainability is the buzz word. It is also regarded as an issue of some urgency. If we want to keep our planet safe for our (grand)children to live in, choices will have to be made on matters such as energy, pollution, waste processing and on other such areas that affect sustainability. But in order to make the right choices, we need information. How do you decide whether a material is sustainable? The term “Cradle to Cradle” (C2C*[1]) is at the core of this issue: all energy, waste substances and toxic emissions produced during the life cycle of a product, plus the environmental impact, will determine the sustainability of a product.

> **“Development that meets the needs of the present without compromising the ability of future generations to meet their own need.”**

This definition is taken from the report ‘Our Common Future’ of the Brundtland Commission, 1987.

Material

Materia has translated this definition into what it really signifies for materials. The requirements that affect sustainable materials cover the whole spectrum, from the design stage to production, processing, usage, maintenance and waste. Sustainability represents just one of these requirements: other matters for consideration are the aesthetic, economic and technical factors that arise.
A material will never prove to be sustainable and successful in the long term, if aspects such as beauty, functionality and economic issues are not taken into consideration. In the development of sustainable materials, the following six guidelines can be for the benefit of the environment:

1. Avoid depletable energy sources
2. Use undepletable energy sources
3. Use renewable materials
4. Use recycling
5. Use lightweight materials
6. Use residual materials

1. Avoid depletable energy sources

Almost half of the energy requirements in Europe are expended in heating and cooling, according to a study commissioned by the European Parliament. Ninety per cent of this energy is generated from depletable energy sources and only 10 per cent by non-depletable resources. The cooling and heating requirements will decrease when insulation is improved. Innovative use of insulation materials offer amazing insulation values. For example, Nanogel or Aerogel offer twice the insulation values of polystyrene foam. Aerogel consists of 97% air that is trapped in silicagel bubbles and is the lightest material in the world.

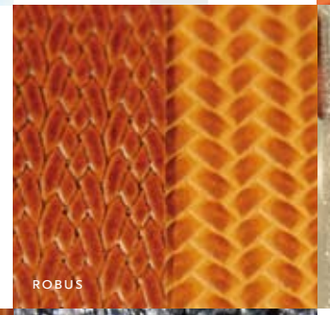
VIPs (Vacuum Insulated Panels) represent a new development in the area of insulation. Double membrane panels are used with a core material holding the vacuum inside the membrane to prevent air from getting into the vacuum area. The core is vacuum-sealed which in turn offers huge insulation values. When this vacuum is filled with nanogel the R insulation values rise even further to 40m².K/W!

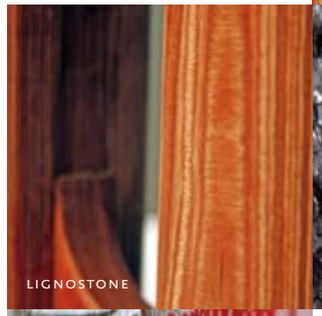
Ninety per cent of our energy is generated from depletable energy sources and only 10 per cent by non-depletable resources.

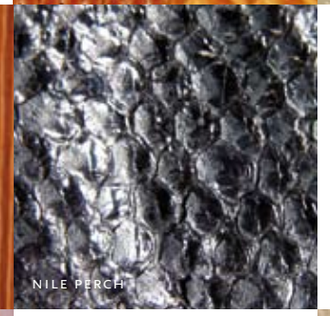
Another innovative approach to energy is heat storage by means of phase-change materials. PCMs can be broadly grouped into two categories; ”Organic Compounds“ (such as waxes, vegetable extract, polyethylene glycol) and “Salt-based Products” (such as Glauber’s salt).

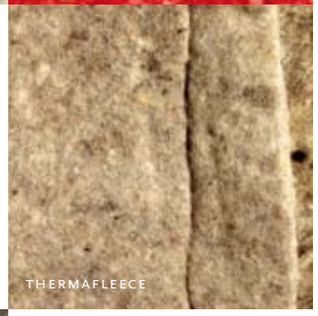
These materials undergo a phase change based on the environmental temperature, thereby storing energy during this process. When cooling off, the materials release energy in the form of heat as they revert to their original phase. Phase-change materials are used for example in BASF’s Micronal*[2]. Use of this material in the construction industry increases the heat accumulation capacity.

Energy is also required for cleaning activities and maintenance. Any reduction or elimination of the need to clean can only be of benefit to the environment. An exceptional material that is self-cleaning is Stolotusan from Sto Isoned. This material is based on how a lotus leaf works. The texture of the lotus leaf is such that water drops are rejected, like a mercury droplet, dispersing all dirt. The decorative plasters and masonry paints containing Stolotusan have a similar texture with the self-cleaning effect*[3].









2. Undepletable energy sources

Solar energy, wind energy and biomass can provide us with ample energy to meet our global requirements. The challenge facing us is to make this energy economically viable.

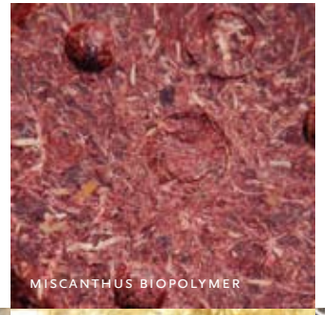
Solar panels made of silicium still remain quite expensive. One alternative is the plastic solar cell. Plastic solar cells are relatively easy and cheap to make. A method is being developed to manufacture plastic solar cells that are transparent and have a higher output. Solar cells generally contain a thin layer which reflects the light and increases light absorption, but they are not transparent. The developer Hadipour went looking for a transparent material that would also be capable of absorbing sufficient light. He finally came upon a fluorescent material that can retain light. The output thus remains high and the solar cell can also be used for windows. Solar cells such as these would provide an ideal solution for large office buildings with many windows, given the enormous energy generating potential.

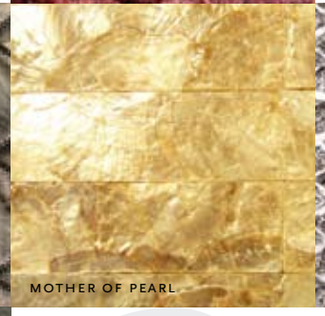
Hadipour says that plastic solar cells offer infinite possibilities. 'Plastic solar cells are light and flexible. We can make them in all shapes and sizes and in many different colours. you could wear them on a jacket, for example, giving you enough solar energy to charge your MP3-player. We could also combine solar cells with an LED (Light-Emitting Diode). This enables the solar cell to generate energy in the daytime, providing light at night.'

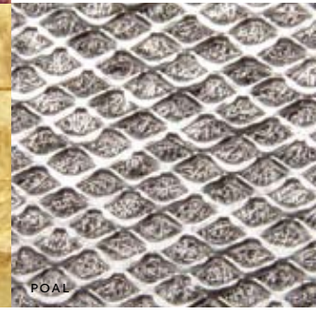
Another type of material that could be used is a roof covering that comes on a roll with integrated solar cells from Alwitra, Trier. Solar panels do not always look pretty. Schott has developed a range of panels together with ASI® Glass which look good, generate solar energy and even provide Solar control.

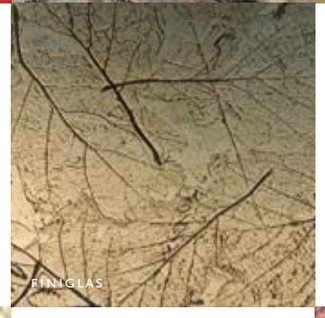
The challenge facing us is to make our undepletable energy sources economically viable.

Wind energy: Prof. Wubbo Ockels of ESA has developed a revolutionary upgrading of the windmill, known as the laddermill. Conventional windmills largely consist of heavy constructional components, enormous columns to allow the mill to catch the wind at great height and long vanes because the outer ends need to make a wide turning circle. It is these outer ends, the tip of the vanes, that are important. This is where the energy is generated and distributed throughout the entire construction. Conventional windmills therefore lose a lot of their efficiency due to the friction. Ockels has developed a flying windmill system whereby a series of wings or kites are connected to a strong cable that forms a huge loop, with a dynamo connected below. The kites are designed in such a way that the upward force generates a lot of wind power; when moving downwards they undergo very little resistance. A much higher output can be generated with this type of flying windmill. Four of these windmills could, according to Ockels' calculation, generate as much energy as a power station (100 Megawatts per mill)*[4].







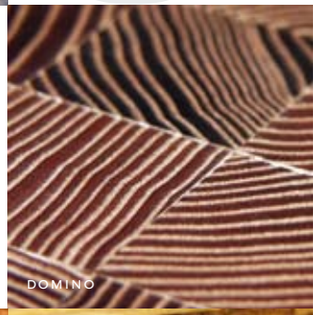


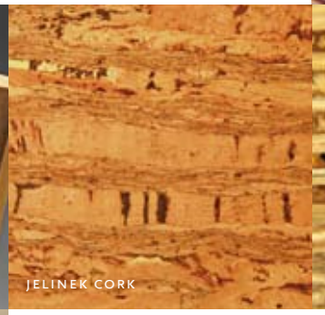
3. **Renewable materials**

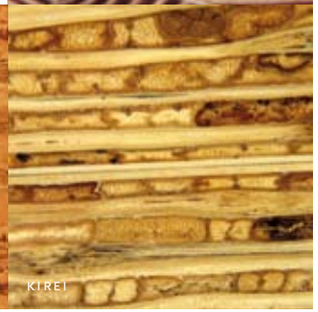
Sustainable and ecological are terms that are used and abused. The best way of determining the environmental impact of materials is to conduct an LCA (Life Cycle Analysis). This allows for the environmental impact of a material to be assessed in a specific application. It is not possible (as yet) to come up with an unequivocal analysis of all materials so that a worldwide LCA quality mark might be awarded. Renewable raw materials include cotton, hemp, flax, jute, timber, cork, straw, sheep wool, reed, coconut, bamboo, starch and linseed oil. Renewable materials can be used in diverse products. Some materials can be manufactured into synthetic granules. The biopolymers are synthesized by modifying starch, cellulose and egg-whites. Another use of renewable materials comprises the combination of natural fibres with conventional plastics. This enables glass fibre to be replaced with flax fibre, hemp or sisal. Finally, colorants and coatings can be made from agricultural products to replace the invariably harmful additives currently in use.

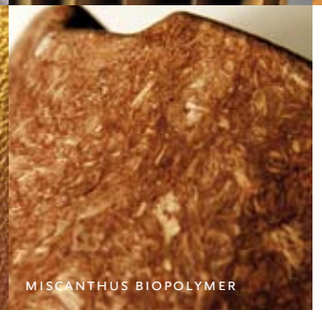
Organic materials from plants and animals can be manufactured into synthetic granules; they can become the plastic of tomorrow!

Leaving all the inventive technical developments aside, the old, renewable material such as wool is a very good competitor on the insulation market. The keratin in sheep wool is fire-retardant and produces a chemical reaction with sulphur dioxide, nitrogen dioxide and formaldehyde. These are noxious gases that may arise in the interior environment of an office complex. The capacity of wool to neutralise these gases is so great that wool insulation will continue to perform this function for many years*6. Nature provides us with other 'old' innovative materials such as nettles and bamboo. The irritant acid from the nettle stalks vanishes when the stalks are dried and the hollow structure gives good breathing properties. The firm of Brennels(*6) turns these fibres into textile. Textile is also manufactured from bamboo and offers comfortable wearing.









4. Recyclable materials

Recycling is regarded as “the market for materials without markets” and can be summarised as waste = food. Is food waste or just a raw material? The amazing recycled material from Anna Bulles called Gumnetic brings all these together. Anna Bulles has developed a full circle recycling scheme for used chewing gum. She collects the discarded chewing gum, boils it to kill the bacteria, mixes this with a biodegradable wax and presto – a bubblegum bin. The ball-shaped Gumnetic bin can be attached to traffic sign posts or walls for people to dispose of their discarded chewing gum. It can also be used as a raw material for other Gumnetic products such as furniture*[7].

In principle everything can be recycled. Thermoplasts can be melted, while thermoharders and other rigid substances can be cut into pieces and reconnected together with wax.

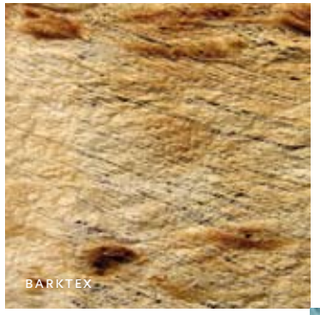
There are two great challenges facing the recycling industry:

- Preventing the degeneration of the final product
- Dividing waste into usable raw materials

Thermoplastics are easy to melt into new products. The melting process degrades the strength and elasticity of the finished product, but this can be improved again with the addition of new pure plastic granules.

Is food waste or just a raw material?

The KLP wall panels of Lankhorst are produced from recycled polyofin synthetic material. As they are made from recycled material, the standard colour is anthracite. This material has generally been used for making parking meters or parking bollards and sheeting and is now being used for wall sections*[8].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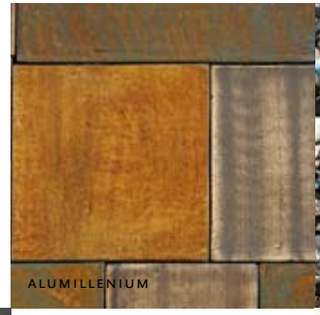
ALUMILLENIUM


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POESIA


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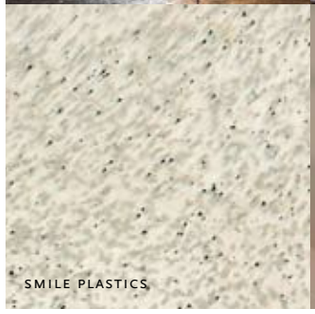
KLP LANKHORST


KOLLAMAT


SMILE PLASTICS

GUMNETIC

5. **Lightweight materials**

Transport is a major contributor to environmental pollution. By designing and constructing lighter materials, we can reduce the energy consumption of transport systems. According to a study by S.M. Lensink of the University of Groningen The Netherlands, 80% of the CO2 emission during transport is caused by road transport. Of this road transport, 40% serves the construction industry.
Ultra-thin natural stone veneer can be manufactured to a minimum thickness of 0.3 mm. By attaching this to a honeycomb panel, a very light construction with a natural stone-like finish is created. A company called Wenzhou in Zhejiang, China, has managed to process these thin natural stone layers in such a way that the expansion coefficient equals that of aluminium. It then becomes possible to attach this layer onto an aluminium honeycomb panel. The layers are so thin that the panels can also be bent*[9].
Very light constructions can be created from sandwich panels such as Greenpanel from Finsa*[10]. This is a three-dimensional panel of multiplex made from MDF which due to the ingenious use of spacers creates a very strong and light material.

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The benefits of using lightweight materials for the construction industry are twofold: less energy is used during transport and less energy is expended in their use during the construction process. Another interesting development is in the area of lightweight concrete where recycled materials are also used (Syndecrete*[11]).

5

6. Use of residual materials

Residual materials tend to be pure in composition and are therefore easy to reuse. Wood chips, rejected products and redundant base material can all be used as raw materials for new products.

One remarkable process is the spraymoulding of cellulose rich fibres. In this process, developed by the firm of Zelfo in Australia, fibres or residual materials are used from the plant processing industries: for example, hemp, sisal, jute and sugar beet, providing they contain cellulose. These fibres are chopped fine, dried and then mixed with water into a workable material. This material is then processed by pressing or by spraymoulding. The finished product is then dried gradually and the resultant strength is good enough to be used in the manufacture of even skateboards*[12].

Wood chips, rejected products and redundant base material can all be used as raw materials for new products.

Duralmond is a material manufactured by a Spanish company of the same name. It grinds almond shells and presses them together with a biodegradable wax. In this way the residual materials of the almond industry can be used in a totally different industry, such as in the manufacture of coffered walls and ceilings. This is a material that can be turned into many shapes and the bonus in terms of sustainability is that the almond shells that they use are the waste product from the nut-processing industry. Duralmond also processes residual waste from the porcelain processing industry. This porcelain is converted into wall tiles*[13].

Residual materials from the metal processing industry are used by the firm of Alkemi which processes aluminium curls into decorative panels*[14].

* For more information check these websites: 1. www.braungart.com 2. www.micronal.de 3. www.sto.de 4. www.ockels.nl 5. www.doschawool.nl 6. www.brennels.nl 7. www.annabullusdesign.com 8. www.lankhorst-recycling.nl 9. www.wz-mt.com 10. www.finsa.nl 11. www.syndecrete.com 12. www.zelfoaustralia.com 13. www.duralmond.com 14. www.alkemi.com

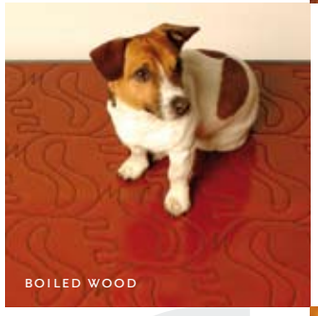

OSCURA


ANTICO


BOILED WOOD


BARKTEX


BOILED WOOD


BOILED WOOD


TT SHEET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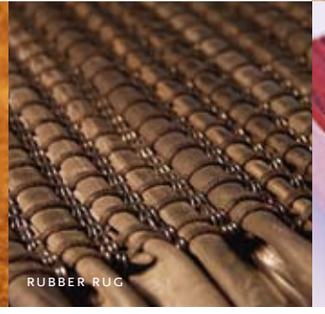
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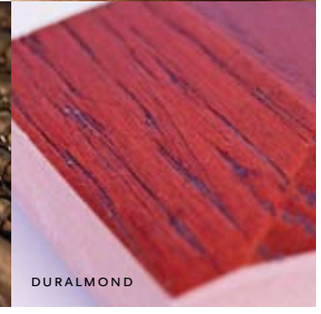
DURALMOND

Materialize the future!

Materia stimulates and inspires architects, designers and producers to apply innovative materials in their designs. After all, new materials provide opportunities for fascinating innovations.

The company knows innovative materials from the whole world and their specific properties, and has set the goal of building the new look of our future, together with the creative professions.

The Materia company has existed since 1998 and offers creative professionals a materials search-engine on the internet, travelling exhibitions, publications, newsletter, seminars, workshops, master classes and consultations.

The materials search-engine from Materia (www.materia.nl) is the only one in the world that is accessible to everyone for free.

The latest development of Materia is the permanent exposition space in Dock 36 where 1,500 materials are displayed.

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