

Industrial ecology is a sustainable production philosophy. Taking nature as a model, it minimizes losses of materials in consumption and production processes mainly thanks to waste recovery.

# When waste becomes a resource

*t*o push the bounds of space exploration it is necessary to create a means of independent survival in shuttles that have a limited capacity. That is the issue the European Space Agency is addressing in its Aurora program. The project involves providing astronauts with oxygen, food and water by collecting and processing their waste products (CO<sub>2</sub>, sweat, urine, etc.). Like in nature, this processing relies mainly on biosynthesis. A permanent cycle is thus created, perfectly illustrating the goal of industrial ecology. "It involves taking a leaf out of nature's book," explains Dominique Bernard, Senior vice-president - Industrial Ecology for Lafarge. "Natural biological systems have reached an equilibrium based on a minimum consumption of water, materials and energy and each species finds its place in a cycle. Industrial ecology seeks to create synergies between human and industrial activities where waste products from one activity are resources for another."

## An urgent issue

Over the last 50 years the burning of fossil fuels has risen by 500%, water use has doubled and the number of vehicles in the world has increased tenfold. Each of the earth's inhabitants simultaneously produces an average of 1kg of waste each day. It is easy to imagine the scale of the challenge when we think that the planet will house 3 billion more human beings by 2050. Industrial ecology attempts to tackle these issues. "Human activity," continues Dominique Bernard, "has always favored an open system linking resources, production of goods and discharge of surplus, waste and pollution. This open system exhausts non-renewable resources and creates pollution."●●●

*Tulsa cement plant's tire stocks used as alternative fuels in the kiln. Oklahoma, USA.*

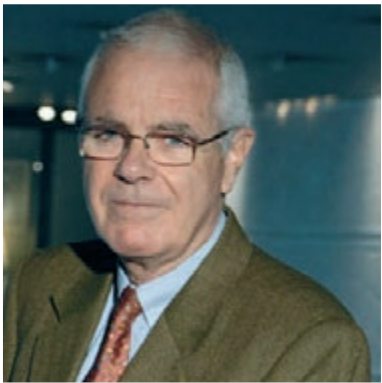
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**DOMINIQUE BERNARD**  
Senior vice-president – Industrial Ecology, Lafarge

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*The Rawang and Kathan cement plants in Malaysia use palm kernel shells as an alternative fuel.*

Industrial ecology, on the other hand, involves creating symbioses between human and industrial activities, particularly through re-using waste, within a loop limiting the use of rare and non-renewable resources. This system is a practical response to the requirements of sustainable development as it reduces the consumption of natural resources, limits CO<sub>2</sub> emissions, provides a service to the community by dealing with waste and can reduce costs.

Challenges faced by cement manufacturers

The extent of the challenges faced by the cement industry in general and Lafarge in particular can be illustrated by a few figures: 2 billion tons of cement are consumed each year throughout the world. It takes 1.6 tons of raw materials and 100kg of oil equivalent as fuel to produce 1 ton of cement. “It is our responsibility to find solutions,” explains Dominique Bernard.

Replacing raw materials with waste

Fortunately there are ‘opportunities’ in cement manufacturing methods which will help to turn things around. For example, the consumption of bauxite as a raw material can be reduced by using waste or by-products that are rich in aluminium, or by using waste instead of iron and silica. In Japan, where there is a shortage of space for waste, up to 350kg of waste per ton of cement is recovered and used as a raw material.

Replacing fossil fuels with waste

Waste products can also be used instead of fossil fuels for firing, carried out at an extremely high temperature of 2,000°C. All the organic compounds are destroyed, like those used in the composition of tires for example, without having a negative impact on the environment. The circulating raw material is converted into lime which is then used to clean the combustion gases. “This means,” says Dominique Bernard, “that the gas scrubber is directly integrated into the process.” In the final grinding phase, it is also possible



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to replace natural gypsum with gypsum resulting from the desulphurization of the gases emitted by coal power plants.

Growing commitment

Lafarge is a pioneer in the field. Since the late 1970's, the Group has been replacing raw materials and fossil fuels with waste, particularly in developed countries. It went one step further in the late 90's by defining a real industrial ecology strategy, and a unique expertise developed, allowing for complete management of industrial processes integrating waste. Placing the impact of its activities on the environment on a par with corporate responsibility and governance issues, Lafarge has a long-term approach to managing its business. Industrial ecology has therefore become a real business in addition to its core business of cement. The Group's Cement business has developed in terms of its professionalism and expertise and at the same time a dedicated organization at Group and business unit level has been set up. “It is the role of each business unit's Resource Recovery department to develop professionalism in this area”,

A TOWN-WIDE INITIATIVE

Located a hundred kilometers west of Copenhagen on the North Sea, Kalundborg is a town with a population of twenty thousand which is home to an original industrial ecology experiment. Companies, authorities and farmers exchange energy, waste and reprocessed materials in a loop. For example, the oil refinery provides hot water to greenhouses, and gas and cooling water to the power station, which supplies it with steam in return. The power station provides heat to the pharmaceutical factory, hot water to the town and fertilizing mud to farmers who provide residual water to a plaster factory which receives synthetic gypsum from the power station, and so on.

A GROWTH SECTOR IN BRAZIL

“We transform waste which would otherwise be incinerated or put into the sewage system into a product that is useful for society,” says Francisco Leme, director of Eco-processa, a waste management company created by a joint venture between Lafarge and Cimpor in Brazil. “In 2006, our company co-processed 115,000 tons of waste and our target for 2009 is 350,000 tons.” Eco-processa was set up in 2004 to supply Lafarge and Cimpor's factories with waste to be used as alternative fuel and is one of the largest waste management companies in the country. Through its network of 10 factories it covers a large geographical area and is used as a model for the whole of Latin America. In its factories in Cantagalo, Matozinhos and Arcos, Lafarge has reduced fossil fuel consumption by 25,000 tons and raw material consumption by 10,000 tons thanks to the collection and recycling of waste.





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*The Milaki cement plant in Greece uses industrial waste waters as an alternative to some raw materials of its cement production process.*

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●● Dominique Bernard continues.

A very clear commitment has also been made: Lafarge makes every effort to reduce the consumption of non-renewable resources by recovering waste whenever possible. Modernizing old, less efficient factories by installing modern technologies has improved energy efficiency and reduced CO<sub>2</sub> emissions. Nearly €100 million is spent each year in technical centers to increase factory efficiency.

**Service business**

Lafarge uses all the means at its disposal in the different countries in which it operates. Fuels Lafarge now uses in its plants include

tires, waste oil, palm oil, rice, coffee and sunflower hulls, as well as purification plant sludge, bone meal, wood, household waste, ground plastic, composite packaging, solvents, paint sludge, ink, varnish and hydrocarbon waste. In 2006, the Group recovered 6.5 million tons of waste throughout the world. Twenty-six of the forty-six countries in which Lafarge produces cement have undertaken an industrial ecology strategy. The Group has developed its expertise relating to the use of raw materials and alternative fuels and, by working alongside waste collection and treatment operators throughout the world, has immersed itself in the specific industrial issues of this high-stake business. ■

Suren Erkman  
“What could be the point of unsustainable growth?”

Scientist and teacher, Suren Erkman is the author of Towards Industrial Technology.



**SUREN ERKMAN**  
Founder and Director of the Institute for Communication and Analysis of Science and Technology (ICAST) in Geneva, Switzerland.

**Why is the study of the biosphere of interest to industrial activity?**

**SurenErkman:** First of all because it supports all activity. It is something we were not aware of when the economic system was still limited. But as it has developed, with globalization, we can see that human activity has a significant impact on the biosphere. We now need to take into account the constraints and limitations it imposes.

Next, man must learn from the biosphere. It is a complex and sustainable system and we need to draw inspiration from it by creating sustainable economic systems in its image. We could, for example, mention inter-company networks drawing inspiration from food chains that are finely controlled systems, particularly through the efficient use of resources.

This does not mean that we need to copy the way the biosphere works. It is more a matter of drawing inspiration from it, which is different. To do this, man's system must be based on scientific ecology. For example, recycling is a necessary activity, but that is not to say we should do it without making a distinction. Certain types of recycling are desirable while others are not.

**How can we ensure that industrial ecology develops within companies?**

**S.E.:** The key factor lies in the fundamental realization that sustainable development is in no way a question of image or advertising. On the contrary, it is a fundamental strategic challenge, not only for the company but for

society as a whole. It involves overhauling the economic system at company and global level. It is not a question of decoration, making a good impression or following fashion. Sustainable development must be at the heart of company strategy, an integral part of the way the company is managed. Too often the approach is incomplete, transplanted from the outside and seen as conflicting with the interests of shareholders. This is a short-term view. What is needed is a redefinition of the notions of benefit and growth. Nothing is possible if we keep the current analysis framework.

**Northern European countries are often cited as an example. But what about emerging countries like China and India?**

**S.E.:** I am quite impressed by what is happening in China. The country's leaders have understood that sustainable development is a major strategic challenge and that it is a question of survival. Of course, implementation is complex and difficult but there is a real desire to make progress at the highest level. The situation in India is more worrying. The people in charge still see sustainable development as an obstacle to economic growth. However, the fact that there is a highly active civil society in India means that we can hope that things will develop in the right direction. ■