Ed van Hinte :

The image of recycling

The days when recycling was controversial are behind us. The environmental issue has in the past two or three years become part of normality, the only negative side effect being a slight loss of interest. We have also come to realise that recycling is not an end in itself, but rather one of many means by which we can decrease the harm of exploiting our own world. An exhibition of quality products made partly out of recycled materials is no longer needed to prove their right to exist. It does, however, illustrate that use of materials which lived a previous life may either enrich the collection of objects with which we surround ourselves, or simply be invisible. Because the presence of recycled materials needn’t be all that obvious.

By now many companies have experienced the benefits of reducing production waste by collecting surplus materials at the end of the line, shredding and melting them and using them all over again. As efficiency is the ratio between overall costs and results, it is simply cheaper to reuse what you have already than to invest in new supplies. The same holds true on a broader scale. If products are recycled after having been used for a certain period of time, regaining the materials they consist of inevitably has to be more efficient than just throwing them in the garbage can, thereby destroying all added value in no time. **Recycling** is a way to make money. This is the experience even of thousands of extremely poor people in third world countries. Their only way of making a modest income is to collect used plastic bags or other things rich westerners consider garbage, and to sell them. Kids in some African countries are renowned for the toys and other ingeniously constructed objects they make out of tin cans, paper and wire. In the west, of course, there is a growing number of successful recycling companies. Recycling, however, cannot be considered separately from the whole system of designing, producing, using and ultimately breaking down objects of desire. The world cannot thrive by recycling alone. Recycling, rather, is an important concept which supports the idea of products going through a 'life-cycle'. Hence the word 'recycling'.

Regarding the **life-cycle** concept we must take into consideration that recycling is an industry that uses energy and may pollute the environment like any other industry. Life-cycle quality may therefore benefit from product durability in many cases. And required properties for a long product life can be contradictory to the demands for recyclability. Durable materials are hard to shred.

In the field of **bioplastics** some very interesting research into what might be called longevity control is going on. In the near future it may be possible to set the time in which a product starts to fall apart. Even so, not all materials should break down by themselves and if they don't we should still be able to use them over and over again.

Statistically, chances are not at all remote that some paper particle from the book you are currently reading once belonged to one of the planks which were used to build a cabin somewhere in New Zealand. The same material reappearing in different objects is not in itself a new phenomenon. It has been going on for ages. And mankind has played an active part in this. People have been reusing materials for as long as they have existed. An English antique cabinet from the 18th century, for instance, may contain oak panels which had been used for a pulpit in a German church a hundred years earlier. On the other hand there has been an enormous change in the rationale behind reusing old materials. Whenever a furniture maker found a couple of interesting old parts, he would set them aside, simply because he liked them and thought they might come in handy later on. Merely leaving the wooden panels, or brass hinges, or whatever instead of reapplying them seemed wasteful to him on a personal level. The vision that the whole planet might be spoiled by everybody dumping stuff all over the place did not reveal itself to anyone. The consequences of vast population growth, together with the Industrial Revolution, put an end to this individual pragmatism. And it happened quite suddenly. At the end of the 1960s a handful of scientists as well as some designers started to realise that things would go wrong if humanity kept on pursuing material happiness regardless of the effects on our **'Only One Earth'.** This is the title of a book by Barbara Ward and René Dubos which set the key for the UN Conference on Human Environment in Stockholm in 1972, the year in which 'Limits to Growth', the renowned report for the Club of Rome, appeared.

Apart from the impending scarcity of reserves which were once thought to be endless food, water, fossil fuels, space and a healthy environment, some people suddenly recognised the detrimental side effects of industrial development.
It became evident that change was crucial. Its direction, however, was yet to be explored and decided upon. Moreover, industry still had to be convinced. This was certainly not easy, as every deviation from the standard way of thinking was perceived mainly as being cost-raising and troublesome.

Nevertheless, from then on, the **environmental** issue gradually gained momentum. Obvious cases of neglect, public protests and activism, research and governmental measures and campaigns to reduce waste and toxic emissions led people to understand that improvements could be made without too much suffering or any trouble at all for that matter.

Most designers were not unwilling to switch on the green light in their studios. Their main problem was that relevant information on environmental effects was difficult to access, certainly from the midseventies until the end of the eighties, when computers were not anything like as ubiquitous as they are now. And if they did succeed in laying their hands on some facts and figures, these were usually not suitable for integration in the design process. New products are by definition developed on the basis of a lot of sketchy data which scientists find difficult to live with. On the other hand, scientists deliver universal certainties which lack relevance to specific design problems, which usually are generic in character.

A major breakthrough came with the realisation that products are not just objects rolling off the end of a production line, but that they go on existing and are discarded in the end. Like people, all of them pass through a life-cycle of some length. Product developers should be concerned with all of its stages, 'from the cradle to the grave'. Every aspect of a new product should be considered: choice of materials, energy consumption, transport, toxic emissions during production, and recycling, that is, the use of recycled materials in new products, as well as their recyclability at the end of their period of use. From the life-cycle concept sprang a very important tool for comparing environmental effects: **Life-Cycle Analysis** or LCA, as it is commonly known. It is a powerful technique for calculating all the factors involved in energy use, waste and emissions for any product or part of it. Some LCA software packages for designers are available on the market and help them take decisions concerning environmental impact of their ideas at an early stage. LCA has its drawbacks, though. It allows comparison only between product options which have already been defined to a certain extent. It is hence not suited to support strategic company decisions in which basic product concepts are still vague, if they exist at all. When it was applied, it did however provide new insights which could be translated for companies and designers into simple rules of thumb to minimise environmental impact. And some of these deal with recycling and recyclability.

The most obvious rule is of course that recycled materials should be used whenever possible. This should reduce environmental costs and make sense in every other possible way. Maybe surprisingly, this is not always the case. In view of recycling, choice of materials appears to be a complex subject.

Aluminum, for instance, is a metal that has been recycled ever since it started to be applied on an industrial scale, because the energy needed for remelting light metal is only a fraction of the amount that is neccessary to extract fresh aluminum from bauxite. Still, an even better choice might be some kind of plastic material, because the generation of plastics and indeed the recycling of plastics may in some cases prove to be much more energy-efficient than **aluminum** recycling. If lightness, stiffness and strength are not important properties in a certain application, then aluminum may not always be the obvious choice. As the matter of fact the preference for aluminum is sometimes based on aesthetic prejudice, and, in the worst case, on plain laziness about trying to find a better solution. Also, the producer may have invested in machinery to process aluminum. Switching to a different material would be a waste of that investment, for the discipline of expressing ecological costs in economic terms still is a long way from maturity, let alone implementation. Natural resources are free and the price of air is always the same, whether it is polluted or not.

The **wood** story is altogether different inasmuch it is not about energy consumption but rather about toxicity. Used or otherwise surplus wood can easily be chipped and made into new materials, like chipboard and MDF. Attractive though this solution may seem, in some cases it can be more harmful than using fresh wood from specially grown trees, because the resin used to bond the chips or fibres together, for instance phenolformaldehyde, may emit poisonous fumes. This needn't be: new, clean technologies for wood recycling are being researched right now. And there are other ways. Some designers have developed interesting proposals for furniture made from old wooden parts without first turning them into fresh material. They have proved that the aforementioned ancient way of reapplication may become successful again.

It is possible for most **paper** materials to originate in trees only as parts of their remote pasts. Paper is relatively easy to recycle. As a matter of fact most paper in Europe is made out of paper scrap and other waste materials such as textiles.

Recycled paper was the first material to establish the image for recycling as a phenomenon. And it wasn't a very positive one. The grey speckled stuff wasn't very strong and its quality ranked even below that of scribbling paper. In the beginning it may even have damaged public reception for the whole idea of recycling. Nowadays many different qualities of recycled paper and cardboard are available. Also, the material is easy and cheap to experiment with. Entirely new varieties evolve from this experimentation. Paper is now used for several three-dimensional products which transcend the realm of packaging. Japanese engineers even constructed a paper bicycle held together by plastic resin.

Concrete is a bulk ceramic material which can easily be mixed with otherwise useless components and used concrete fragments. The last couple of years have seen numerous developments in this field. Recycling fired ceramic materials, however, does not make much sense from the environmental point of view. Energy consumption is just about the same, whether the materials are pure or mixed with ground pottery. And in terms of waste, these ceramics can hardly be considered harmful. After all, we built brick cities on top of each other for centuries. However, mixing pure clay with small fragments of used pottery might be considered an interesting option for aesthetic reasons. Products made in this manner offer a new material expression.

Recycling **steel and iron**, although probably known as remelting and rewelding in the past, has quite a long tradition. These days reprocessing scrap iron happens on a massive scale, if only because the most wanted consumer product of all times, namely the car, is made largely of steel. This category of recycling has its specific environmental problem, which evolved about ten years ago, when car producers started to provide car bodies with a thin layer of zinc to prevent them from rusting. In this way a car's useful life-span was prolonged. At the same time, though, recycling was hampered by the zinc oxide that remained after processing used-up bodies.

This illustrates an important prerequisite for recycling: the material flow must be kept as pure as possible. And that is the very reason why a **plastics** recycling system is extremely difficult to set up. There are two, or rather three main groups of plastics, each consisting of numerous different materials. The first one is called

thermosets. These are characterised by the fact that they evolve from a heatproducing chemical reaction and are impossible to melt. The only and not very profitable way to recycle them is to grind them down to small particles which can be added as a filler to new thermosets. The second and very large group consists of thermoplastics, chemically synthesised raw materials which soften when exposed to heat. All of them can be recycled but preferably not mixed together, seeing that only a few of them are really compatible. The last group, the so-called **bioplastics,** is becoming more important every day. These biodegradable versions of thermoplastics are made of starch or bacteria generated molecules. Their advantage is that they break down easily on exposure to either moisture or composting bacteria, one drawback being that they may be a serious threat to the quality of regular thermoplastics by contaminating them.

The main concern of plastic recycling companies is therefore **logistic control** of the material flow. This has several implications. The main one is that the input of used plastics is large enough to permit profitable and competitive processing. Furthermore the spectrum of different plastics should be narrow; this could be considered contradictory to their very nature, as new plastics variants are created almost daily. The last point is that different plastics should be easy to identify. Quite a lot of research is going on in this field, but the most important improvement is that for four years now, every bulk plastic product in Europe has had to carry a compulsory label indicating the name of the plastic.

Some drastic flow control projects have been initiated. For instance, a disposable coffee cup producer set up a retrieval system together with user companies for the purpose of making new cups directly from used ones, a radical way of doing the dishes. And of course most car manufacturers are creating disassembly facilities so as to retrieve the materials in their products. The same thing is happening, albeit belatedly, in the field of computers and consumer electronics. And a plastic garden furniture manufacturer made a similar attempt which proved unsuccessful, however, because he was unable to convince his competitors to start processing standard materials. But producers simply have to start up these activities, for in the near future they will be compelled by law to take back everything they produce. In Germany producers already have to take back packaging materials, cars and electronic equipment.

Most recycling implications for design concern the choice of materials. Apart from being preferably recycled already, there has to be a slight variation in different materials per product. For plastics this is advantageous because they allow the integration of many different functional parts (which, for instance, serve as attachments for technical components) into a single, complex shape.

Furthermore, they must preferably be pure, that is unfilled. Composite materials don't like this argument, because they consist of a socalled matrix of one material and a filler of another. A typical example is plastics which are reinforced with glass or carbon fibres. In some of these it is difficult to separate the components once they are bonded together. This means that advantages of composites, such as strength and resistance to wear, should outweigh the disadvantage of difficult recyclability, before deciding to apply them in a product. Fibres which can easily be burnt, as is the case with carbon and all **renewable materials** such as jute, flax, or hemp, shouldn't pose too much of a problem. Some interesting prototyping has been going on with these composites, and last year Mercedes Benz fitted jute reinforced interior panels in one of their models.

It is not entirely impossible to recycle classic glass fibre composites. Depending on their composition they may be shredded and added as a filler to a compatible plastic. But this usually entails a degradation of their properties. Generally speaking, plastics cannot be recycled endlessly. Their properties will gradually deteriorate with each cycle. And each time they have to be applied on a lower level. A plastic starting out as a high grade technical car component may finally end up in the road surface we drive cars on. This phenomenon is usually referred to as the **recycling cascade**. It is one of the reasons why recycled plastics are often combined with fresh 'virgin' material. The cascade idea teaches us that recycling should take place on the highest possible level to destroy a minimum of added value. Turning an advanced component made out of a highquality plastic directly into a cheap road surfacing material is a waste of money.

One aspect of design that improves recycling properties has not yet been mentioned: **design for disassembly**. Whereas products were formerly constructed to facilitate their easy and cheap manufacture, the opposite is now equally important. It should be just as easy to take them apart and separate the components according to their composition. Some companies, in particular car manufacturers

such as BMW (No.72), and computer producers are already experimenting with production in reverse along what might be called the disassembly line, something Henry Ford, allegedly the inventor of mass production, could never have envisaged. The key question is of course: is all this effort worthwhile? Well, there is no true scientific evidence as yet, but we are certainly getting strong signals from the so called **Eco-design program.** In this experiment eight major Dutch companies, together with design firms and supported by the Ministries for both Economic and Environmental Affairs, carried out a corresponding number of projects aimed at minimising the environmental impact of a given product or component. Five of these projects (an office chair, a protection mask, a lounge chair, a hot plate and a swing) involved aspects of recycling. The overall outcome was that the adopted measures cut costs by an average of about 25 per cent. This result attracted considerable international interest and is now used systematically to convince more companies to optimise their products as well as their production lines.

The necessity for recycling in its broadest sense is no longer open to discussion, although it is not the panacea it was originally expected to be. In every instance LCA will have to help decide what the most environmentally friendly solution is for any given product. Apart from that, one may wonder what the implications of recycling are for design aesthetics. Emptying landfills and **saving junk** from the incinerator appears to help generate ideas for new materials and technologies and to be an inspiration towards new concepts. But at the same time, and paradoxically, the manifestations of recycling seem to disappear, either because we get used to them or because their absence makes no noticeable difference. To marketeers this seems to be a concrete problem. As the environmental issue becomes more important, manufacturerers want to demonstrate their commitment to the products they make, to seduce supposed environmentalist consumers into buying them. They passionately endeavour to ride the wave of **environmental consciousness,** forgetting that a certain appearance is not an expression of ethical decisions, but a consequence of them.

Some time ago this led to a remarkable incident. A plastics manufacturer was approached by one of his customers who wanted to use recycled material for a new product and wondered whether it could also be given an obviously 'recycled' look. He was aware that there is virtually no visible difference between virgin and regenerated polymers. The producer was taken aback, since his efforts had been

largely devoted to achieving the opposite: to eliminating differences between virgin and recycled raw material. The debut of recycled paper had caused recycling to be associated with an uncontrolled and even a clumsy speckled appearance. And from the manufacturer's point of view this had to be prevented at all costs. After all, many years earlier recycled aluminum had been quite common without anyone noticing any difference. Indeed, there is none.

Aesthetic implications of recycling can be discussed according to the kind of transformation that takes place. The least complex is of course straightforward reprocessing of scrap aluminum, steel, paper, or plastic into exactly, or almost exactly, the same material with the same expression. On a laboratory scale scientists are exploring ways and means of breaking down waste materials into the very atoms and molecules of which they consist, in order to reassemble them again into pure materials according to exact specifications. Much more interesting, designwise that is, are attempts to combine waste particles and fragments into new materials. Because in these cases the rationale behind recycling consists not just of sparing the environment, important though this may be, but also of discovering new aesthetic properties and new ways to add value, thus contributing to the quality of our surroundings. From that inspiration the concept of recycling as we know it can only prosper.

Transformations of this kind can be classified simply according to the complexity of the processed waste components. At one end of the spectrum they can be just small particles of material, at the other they may be complete technical parts or even entire products put to a different use. A very interesting example of particle recycling is the idea of Neolite, put forward in 1991 by O2, a European network of environmentally interested industrial designers initiated in Denmark and the United Kingdom. Neolite is a material which consists of scrap PVC from household packaging and was subjected to **aesthetic experiments** at the Domus Academy in Milan. The browngrayish material as such was not particularly appealing, but its visual properties could be improved by the addition of various kinds of metal dust or even sand. It was not very strong though, and this is perhaps one reason why it hasn't been heard of since, another one being that, ironically, PVC household packaging is no longer available in most European countries because of its toxicity during incineration. Even so, the principle does point in a direction which may prove to be fruitful in the near future.

Many experiments of the Neolite kind have since been conducted and are still going on. Cardboard and notably paper have been subjected to intriguing tests. They seem to lead to materials with a variety of technical properties and restrained colours with interesting textures and fine, unpredictable patterns of bright coloured particles. Perhaps this unpredictability is an important aesthetic quality, comparable to, say, wood graining. The American scientist Stuart Walker refers to it as **'microcomplexity'.** A somewhat crude example is the sheet material made from plasticised cardboard soft-drink cartons. And it is not just the expression of the material itself that is affected. Design starts at the edges, the places where form stops or changes direction. The way in which shapes are created and in which new materials react to different treatments generates new kinds of rims, brinks and curves. For instance the shell shape of the Olio stacking chair made in Japan (No. 54) from paper and resin would look totally different if it were made from vacuumformed plastic sheet, which in its turn would have had a different look from bent aluminum sheet or moulded polyurethane.
Right now a new material is being developed by a German company: a very thin kind of plywood consisting of paper sandwiched between two layers of veneer. Reportedly strong and extremely flexible, it may add the dimension of sharpness to bent wood.

We are not merely talking about visual characteristics. Edges can provoke a certain experience when touched, and obviously a cardboard surface has an idiosyncratic feel to it, softer and warmer than most other materials. Recycled paper applied on a large scale in furniture may forever change living environments in the tactile sense.
And let's not forget **smell** either, a sense which designers tend to neglect.
A room filled with lacquered wooden furniture has quite a different atmosphere from the same room with comparable furniture made of polished rust-proof steel or blank recycled cedar wood, simply because of the different smells. Last but not least: materials give off a characteristic tone when they are **touched** or when they move as parts of various kinds of mechanisms. Vast amounts of money are spent on optimising the sounds produced by complex products like cars. Strangely enough, though, hardly any attention is paid to the **sound** of the actual materials, despite the fact that most available plastics, for instance, are far from convincing in this respect. A considerable amount of new knowledge and experience needs to be gathered in this field. Because of their softness and flexibility, larger

shreds of textiles and leather can be used to create new materials. Due to their size, they express the worn-out versions of the properties they possessed when they were still new. Extra quality must therefore be sought in interesting combinations. Now, this is extremely difficult, for specialist aesthetic judgement is crucial for controlling every possible combination. To produce worthy materials of this kind on an industrial scale can be considered a major challenge.

Application of complete used parts is a different story altogether. Because they are complete constructions, they impose their presence on the character of the new product they're a part of. Careful consideration is neccessary. The chances of success are greater when the used elements are simpler. An interesting aspect is that using existing components implies that they don't have to be designed and that no new tooling is needed to produce them. This implies that even if they are new they leave a **'small ecological footprint'**, as John Thackara, the English director of the Dutch Design Institute remarked, compared to specially designed and manufactured parts. Apparently recycling does not always have to involve waste. One can also 'recycle' complete technological concepts by integrating them in products they were not originally meant for.

As environmental friendliness is becoming accepted we find ourselves living in a world which is more and more recycling-minded. It is difficult to forsee all the aesthetic consequences as Ezio Manzini points out elswhere in this book. For we are not only talking about individual products but also about society and all of the activities surrounding recycling. There are numerous implications. Manzini mentions the sound of bottles falling in glass containers. But there is also the smell of used cardboard boxes in the supermarket, or the graphics on the truck that collects leftover polyester from factories, and even the behaviour of the people who pick up waste from the sidewalk or perform other services connected with recycling one way or another. Objects may no longer be considered regardless of the context in which they exist.

Obviously this is something we have to consider very carefully. The American philosopher Don Ihde defines **'scripts'** as the implicit instructions for use that products carry and express to individual users, as well as to society as a whole. Thus an object made of recycled material and made in such a way that it can easily be disassembled to be recycled again carries a script which tells us that we

live in a prudent society which exploits its natural resources carefully. Furthermore we may learn from it what we must do to return it to the **material metabolism** when we discard it. Beyond that it even presupposes the existence of industrial activities and an infrastructure that will break it down and turn it into something new.

The other side of this script is its implication that there is no harm in taking the product to the rubbish dump if we want to, because after that everything will be taken care of automatically. The danger is that this may lead us to forget that objects have a certain value and don't always deserve to be thrown away just like that. Industrial designers should therefore take care that products express both their participation in a complex cyclic process and their **intrinsic value** and dignity. This can be achieved. This exhibition provides the evidence.

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