Energy Conservation, the Environment, and Vacuum Metallizing

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ABSTRACT

One of the major concerns today is the high level of energy use. This becomes more critical with the increased cost of energy and the depletion of the earth's resources. This has played a leading role in the development of vacuum metallizing and the acceptance of vacuum metallized products. The material and energy saving possibilities can be dramatically illustrated by comparing different products. Van Leer offers the widest portfolio of direct and transfer metallized products that are designed to be, and are accepted as, more environmentally acceptable than competitive materials. Generalizing, both the direct and transfer metallized papers have been shown to be recyclable. With specific products, attention will be addressed to particular "green" advantage of metallized materials.

INTRODUCTION

Van Leer Metallized Products produces direct and transfer metallized paper, film and boards. Direct metallized materials are produced at our facilities located in Caerphilly, United Kingdom, Blaenavon, United Kingdom and Framingham, Massachusetts, USA. Transfer metallized materials, using a Van Leer patented process, are produced in Amsterdam, The Netherlands. With these four metallizing facilities Van Leer is the largest metallizer in Europe and one of the largest in the world.

Very briefly I'll explain the direct and transfer metallizing processes.

Direct Metallizing: The vacuum metallizing process is a batch process. The film to be metallized is loaded onto the unwind zone of the vacuum chamber threaded around the cooling rollers and onto the unwind stand. The vacuum chamber is sealed and evacuated. Aluminum wire is heated and evaporates and condenses onto the film as it passes the cooling roller. The deposited layer is approximately 300-400 Angstroms thick (0.03 to 0.04 microns). Direct metallized paper and board uses the same process as film but the paper and/or board is first primed to seal the surface and to give improved smoothness to the surface. The paper and/or board is then vacuum metallized and remoisturised to replace moisture lost in the vacuum chamber. Finally, the paper and/or board is post coated with a print receptive lacquer.

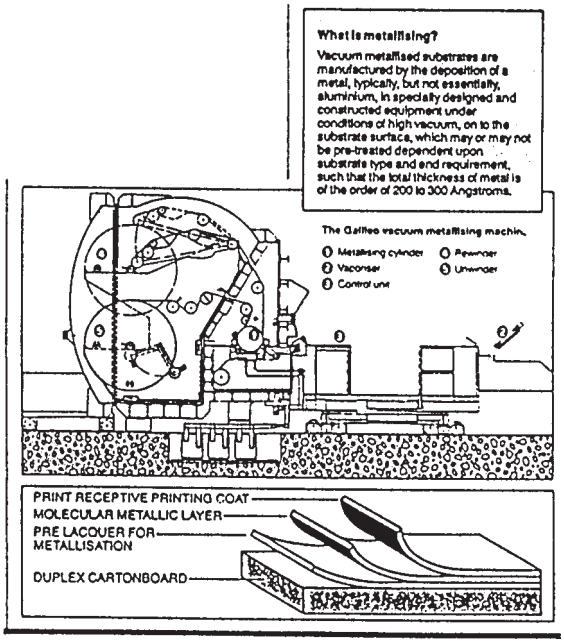

ILLUSTRATION I

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Transfer Metallizing: The transfer metallizing process is somewhat new.

There are several patented transfer metallizing processes. The Van Leer process consists of four elements or steps: Coating, Metallizing, Laminating and Splitting. The steps are described in the illustration below.

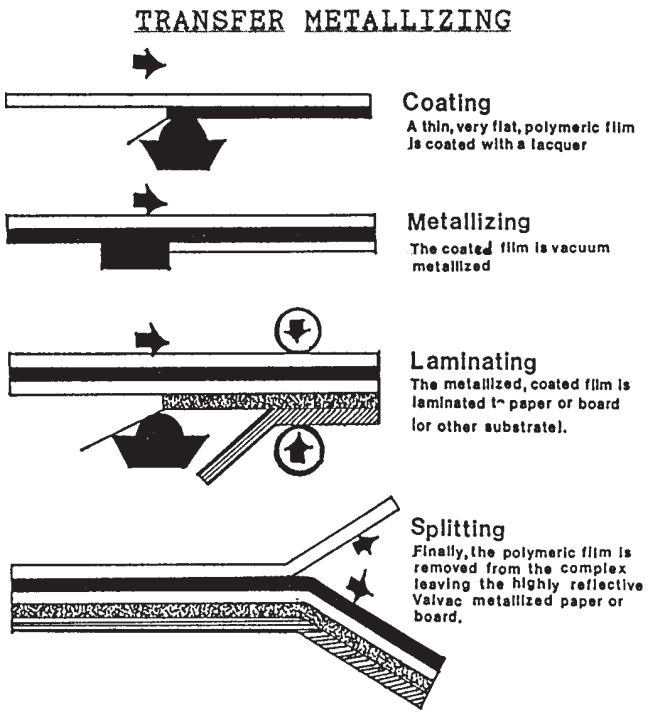

ILLUSTRATION II

In the rapidly intensifying debate on solid waste management consumer packaging is receiving the full attention of environmental groups and legislators. Legislation implemented or in progress varies from country to country but is particularly extensive in Germany, Switzerland and the Netherlands. European Economic Community (EEC) legislation will — if not completely, at least significantly — be based on standards set by Germany and The Netherlands.

What are the waste management objectives of governments?

* **Volume Prevention and/or Source Reduction**
* **Reuse**
* **Recycling**
* **Incineration**
* **Landfill**

The first waste management consideration of government is volume prevention and/or source reductions (Source reduction is defined as the design and manufacture of products and packaging planned to reduce the amount of waste they generate.) This is being quantified by certain European countries as a 10% solid waste reduction by the year 2000, using 1986 as the reference year.

How is this reduction to be accomplished?

> **Reduction of carrier and other bags made from virgin materials**

> **Avoiding the use of blister packaging.**

> **Avoiding over or extra packaging.**

> **Reducing volume to stop packaging air.**

> **Reducing or eliminating multi-structured laminates made from different materials.**

For Example:
- ALUMINUM FOIL AND BOARD
- ALUMINUM AND PAPER
- POLYESTER AND LDPE
- POLYESTER, FOIL AND LDPE.

As we move toward recycling, these multi-structured laminates are difficult, if not impossible to recycle. These multi-structured laminates need to be replaced by mono-structures or structures of the same material. Alternate structures can consist of metallized films or metallized papers or multiple layers of OPP or PET.

In the September/October 1990 issue of **"THE JOURNAL OF PACKAGING TECHNOLOGY,"** an article appeared that gave a brief overview of the aseptic packaging ban that was introduced in Maine. These are the brick packs or juice boxes that are sold in many stores. The Maine solid waste bill that was passed in 1989 prohibits the sale of containers composed of a combination of aluminum and plastic or of aluminum and paper. Maine's solid waste bill prohibits packaging that contributes to environmental problems. It bans six-pack yoke connectors, which are harmful to wildlife, polystyrene manufactured with chlorofluorocarbons (CFC), which are harmful to the ozone layer, the "plastic can," another type of multi-material packaging that cannot be recycled, and cans with detachable flip top openers. The objective of the Maine bill is to recycle 25% of the solid waste by 1992 and 50% by 1994.

An additional preferred waste management option is reuse. The best example of re-use is the returnable soft drink and beer bottle and refillable containers.

Recycling is the third preferred waste management option. Recycling in the long term must be commercially viable. It could well mean that the use of some materials for packaging will no longer be possible if recycling is not technically and/or economically feasible and incineration or landfill the only means of disposal.

The two least preferred means of waste management are incineration and landfill.

Incineration is not considered an ideal method of disposal. It is regarded by certain governments as a waste of resources. Emission of environmentally unacceptable materials is seen as a serious problem especially in view of the ever advancing detection technology.

Thermal recycling is only considered when equal to the caloric levels of a coal heated power station.

Landfill will be prohibited by the year 2000 in certain European countries. Statistics say that each U.S. citizen produces 4 to 6 pounds of waste daily. Of this, approximately 80% is still disposed of in landfills. The number of landfills is diminishing, from 18,500 in 1979 to 9,300 in 1986 and hundreds are disappearing annually because of environmental concerns or capacity limits.

Industry must reckon with the fact that incineration and landfill will become very expensive disposal methods, whose cost may be raised for political reasons to stimulate recycling.

This very complex problem affecting all of us personally as a citizen and in our business is briefly introduced to set the scene for the link between the solid waste prevention or disposal management and the contribution the metallizing industry can make to reduce this problem.

We, Van Leer Metallized Products, would like to share with you our experiences gathered in the past several months in our dealings with environmental lobbying groups, governments, food producers, retailers, aluminum producers, converters and others.

The Green Parties in The Netherlands are dominant and influential. Green Parties in Germany and Switzerland are thought of as influential. Following a report titled: **"Aluminum in Packaging, Squandering of Resources,"** issued in August, 1990, the Dutch government, followed by other governments, plans to reduce the volumes of aluminum used.

Why is aluminum in packaging suspect?

- DESTRUCTION OF THE LANDSCAPE AS LARGE VOLUMES OF RED MUD ARE GENERATED BY MINING BAUXITE. Approximately 2 tons of red mud containing chromium, iron and zinc oxides are generated for each ton of aluminum. these elements are then suspected of contaminating ground and surface water;

- DESTRUCTION OF THE ECOLOGICAL BALANCE BY OPEN MINING;

- EXTREMELY HIGH CONSUMPTION OF POWER COMPARED WITH OTHER MATERIALS DURING MINING, SMELTING, ROLLING, ETCETERA;

- EMISSION OF ENVIRONMENTALLY UNFRIENDLY MATERIALS DURING THE VARIOUS STAGES OF PROCESSING;

- DIFFICULT IF NOT IMPOSSIBLE TO RECYCLE IF USED IN COMBINATIONS WITH OTHER MATERIALS. FOR EXAMPLE, LAMINATES OF ALUMINUM FOIL AND PAPER OR FILM. According to Alcan Rorschach, if the aluminum content is less than 75% it is not economically viable to recycle the material.

The Aluminum industry does not agree with all the data that was used in the report, but many aspects of the report highlight well known arguments. We should also tell you that aluminum is not the only material on the suspect list. PVC (Pvdc) is also high on the list.

Aluminum is of course an excellent barrier material and aluminum has many other advantages. In our metallizing process we deposit an extremely thin layer of aluminum on the surface.

Therein lies one of the inherent benefits of vacuum metallizing as a reduction source. The metallizing processes were invented as an energy saving processes. In those days the environment was not considered of paramount importance.

The production of aluminum foil, as has been previously stated, is highly energy intensive. It is produced by first the electrolysis of fused cryolite to produce aluminum ingots and then rolled down to as thin as 7 microns. High electrical currents of approximately 100,000 amps and high temperatures of approximately 1000 degrees centigrade are not uncommon in the process. Considerable energy savings can be realized when we compare the energy used for the production of aluminum foil versus the energy required to produce

metallized materials. A typical construction of 9 micron aluminum foil laminated to board or film requires 4350 kilo joules per square meter of energy to produce versus 92* kilo joules per square meter to produce a .009 micron metallized substrate. **This results in a net energy savings of over 98%.**

*This figure is the industry average measured by the European Metallizers Association, Technical Committee.

To further highlight the savings by using metallized products, we can compare the yield from 1 kilogram of aluminum used to produce aluminum foil and metallized products. Again, using the typical construction of each, the aluminum foil will yield 41 square meters while from 1 kilogram of aluminum we can yield 9200 square meters of metallized products. This is enough metallized material to cover two football fields. (These are European football fields that we North American call Soccer fields.)

Metallized materials were developed using the assumption that since such thin layers of aluminum could be employed it was argued that one must be able to produce metallized materials cheaper and, it was thought, replace aluminum laminated materials. In part this is true, metallized products have replaced many foil laminated products and have the potential to replace many more.

Metallized products can and have replaced foil for the packaging of butter and margarine, dairy products, tobacco, coffee, chocolate, biscuit and snack food packaging.

Substitution Foil by Metallized Prod.

Products	Barriers	Substitution?
Butter/Margarin	**UV/light grease**	**YES**
Dairy prod.	**UV/oxygen/fat**	**YES**
Tobacco	**Aroma/H20**	**YES**
Coffee/Chocolate	**02/CO2/grease**	**YES**
Biscuits/Snacks	**UV light/H20**	**YES**

ILLUSTRATION III

Comparison of Barrier-properties

Material construction	O2	H2O	CO2
12 mc PET/75 mc LDPE	**100**	**4.6**	**300**
PVDC + 12PET/75LDPE	**10**	**4.2**	**30**
12 PETmet/75 LDPE	**<1.0**	**<1.0**	**10**
12 PET/9 ALU/75 LDPE	**<1.0**	**<1.0**	**<1.0**

ILLUSTRATION IV

In western Europe the total production and sales of aluminum foil for 1990 is 518,000 metric tons.

Est.useage of Alu-foil in Europe in 1990 & Substitution by Metallized substrates

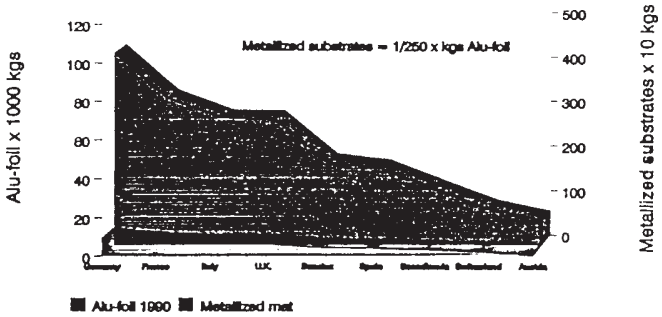

ILLUSTRATION V

The thickness of a metallized layer is approximately 1/250th of an 8 to 9 micron foil. In theory then reduction or prevention of sources is 518,000 tons divided by 250 which yields 2072 tons. This means that by using metallized materials a theoretical savings of 516,000 tons can be realized.

As we move toward recycling additional benefits of metallized materials are realized. Metallized films can be considered as mono-structures, or better stated as homo-polymers. The same can be said of metallized paper or board. This means that in household recycling at the consumer level, metallized materials can be included with the paper, plastic and glass without further segregation.

This is not without its problems, metallizers are faced with an identity problem. If it glitters it must be foil is a common misconception by even those that should know the difference. A major glass recycler said that bottles with aluminum

or metallized labels could not be recycled because the metal caused bubbles in the new glass. The furnace operator saw "shiny" labels and grouped aluminum and metallized together as shiny labels. Again, because the metallized layer is so thin on metallized paper, it does not contaminate the glass recycling operation.

We are currently working on the authorization and certification of metallized materials as a recyclable material in Germany. We expect to have this certification within the very near future.

To summarize - what is happening in The Netherlands and Germany today will be the law in Western Europe (EEC) tomorrow and will possibly be applicable in the U.S. in the not to distant future. Unnecessary packaging will be eliminated. The volume of packaging will be reduced. In particular there will be a move to reduce the amount of aluminum in packaging. The use of metallized materials is a most effective way of reducing aluminum in packaging while maintaining such properties as barrier etc. to prolong shelf life. As a consequence of these moves vacuum metallizers in both Europe and North America are looking at a bright future in more ways than one.