Packaging of Powdered and Liquid Detergents

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ABSTRACT

The "state of the art" in packaging powdered and liquid detergents is presented and discussed with reference to (a) formulations of detergents and subsequent packaging material requirements; (b) recent trends and developments in specifications, shapes, volumes, and systems of packs and packaging; and (c) filling and metering machinery.

INTRODUCTION

The objective of this paper is to provide a survey of present practices in packaging powdered and liquid detergents, and of trends and recent developments both in materials and presentation.

By detergents is meant fabric washing agents, fabric conditioners, and dishwashing agents, both liquid and powdered.

The basic technology of detergents packaging on the whole has not changed significantly over the past 10 to 20 years. However, a number of technological modifications have been introduced.

The good detergent pack is characterized by the following criteria: (a) marketing: good display, product identification; (b) low cost: achieved by cheap material specifications, automatic packaging, and optimum utilization of space in storage/transport/shelf (due to stackability and ease of palletizing); (c) protection of the contents, and (d) consumer convenience: easy to carry, easy to open and reclose, and easy to dispose of.

The two major functions of a detergent pack are (a) protection of the contents during distribution and usage and (b) presentation, good display, and product identification.

Both these aims have to be achieved under increasing cost pressure, so every pack is a compromise between cost, protection, and presentation.

PACKAGING POWDERS

The protection aspect in the case of powdered detergents depends on their formulation and ingredients. They do or do not require protection against moisture and water vapor. Let's look, to begin with, into the relationship between formulation and packaging material.

For products containing 0.8% uncoated enzymes and perborate, moisture protection is necessary. For nonperborate enzyme formulations, moisture protection may or may not be necessary depending on caking problems. Without this protection there could be a danger of caking as a result of moisture absorption or of reduced washing efficiency. Nonenzyme products almost always are packed in nonprotective cartons; whereas high nonionic formulas, which were introduced in Europe some time ago, require a good barrier of polythene-laminated board and a special varnish to prevent "bleeding out" of the printing inks.

The overall use of packaging with barrier properties worldwide has diminished in recent years. There are several reasons for this trend: (a) the big saving, of course, sometimes resulting in a reduction in cost up to 50%, depending on the supplier and his equipment; (b) technological progress toward more stable formulation by enzyme coating; (c) improvement in distribution and its control; and (d) better knowledge of the relationship between protection by packaging and washing efficiency.

It is interesting to note that there are no great differences in the relationship between formulations of powdered detergents and packaging specifications between the developed and the developing countries.

Now, what are the methods currently used to provide moisture protection?

Table I shows us the list of possibilities, the respective barriers achievable, powder flow properties, and rough cost indices. This chart gives a highly simplified summary of the results of storage tests carried out at 4P. It is self-explanatory, but two points need to be made: (a) The data given on barrier properties refer to flat material and ready packs. It can be clearly seen that the difference in product flow properties between the four types of cartons depends on how effectively the cartons are closed. Although the intrinsic barrier properties of the polythene-laminated board were the worst, the polythene-laminated packs showed the best powder flow properties because the moisture absorption was more uniform throughout the carton, and the closure efficiency was the best of all. The reverse is true for foil-laminated cartons. (b) The cost index, of course, is heavily influenced by the production and converting equipment available to the specific packaging supplier.

Let's turn to the aspect of presentation and product identification in powdered detergents packaging and look at the relationship between market needs, consumer habits, and competition on the one hand and volume of packs, their shapes and designs, and systems on the other.

Market conditions and consumer habits vary greatly between developed and developing countries and so do detergents packs.

In the developed countries there is a trend toward larger volume packs, and consumer convenience plays a large role. There we have mainly folding cartons in a variety of sizes, standardized as in Europe, where we have the so-called E-sizes, E1 being 750 cc, E2 1500 cc, etc. For larger volumes of 3-5 kilos, there are the multi-kilo packs, either in board of E-flute, with or without a polythene bag, with or without an E- or B-flute inner stiffener for better stacking, and with a variety of carrying handles (polythene or incorporated in the board construction). An oriented polypropylene tape, glued on the inside, is provided for easier opening.

Another detergents pack for volumes of 3-10 kilos, at roughly double the cost of a multi-kilo pack, is the drum, spirally wound or convolute, with a label and handle, mostly with an inner polythene bag. A more recent and interesting development in this area is the rectangular drum, giving improved presentation and better use of storage, transport, and shelf space.

Less widely used than the cartons and drums and often for so-called "value for money brands" are polythene bags for 2-4 kilos, sealed top and bottom, with carrying handle. They are made of two layers with sandwich printing, or of

TABLE I

Characteristics of Packaging Materials

Characteristic	Packaging Material			
	Foil laminated	Wax laminated 20-25 g/m^2	Polythene laminated 20-23 g/m^2	Polyvinylidene chloride, gravure varnish 9g/m^2
MVTR[a] of boards (gsm/24 hr at 25 C/75% r.h.)				
plain	—	2-4	8-10	
creased	0-0.5	3.8	10-12	
across-side seam	8-11	8-10	13-15	12-14
MVTR of cartons				
average moisture absorption after 24 weeks at	56 g	30 g	50 g	
25 C/75% r.h.	9%	6%	10%	
Flow properties after storage	Worst	Average	Best	Average
Cost index, untreated board = 100	130	110	110	105

[a]MVTR = moisture vapor transmission rate.

only one layer, which often causes problems of ink abrasion. The overall cost of using polythene bags is high compared with cartons despite lower material costs of the bag itself.

Another idea used some time ago in Germany and recently in the U.S. is the use of a clear plastic container for a heavy duty powder detergent where the cap is used as a measuring cup.

In the developed countries there is a trend toward bigger packs, mainly in the form of multi-kilo packs and to a lesser degree in the form of drums.

In the developing countries cartons are also used, and there are some countries where these are the main pack. In the majority of developing countries the bulk of NSD powder, however, is packed in sachets from 40 g to 2 kilos. The material used is either polythene-coated paper or unsupported polythene, often depending on the availability of domestic sources of supply. Sachets are cheaper than carton packs and provide enough possibilities for decoration and printing of information.

An interesting variation is the so-called self-opening satchel pack used in Argentina.

For bigger packs we again find polythene bags with handles, made from flat extruded or blown film, or multi-kilo packs. Because of lower buying power the convenience aspect in the developing countries is less important, and small packs play a larger role.

PACKAGING LIQUIDS

Turning to heavy duty liquids, liquid fabric softeners, liquid soaking agents and dishwashing agents, here we are concerned mainly with bottles and, in some countries, with sachets.

Detergent bottles are almost exclusively blown from polythene or polyvinyl chloride, which are both suitable materials. However, we all know about polythene and polyvinyl chloride and the technical problems of environmental stress cracking with polythene is used for detergents with aggressive formulations. These tend to dissolve the polymer chains and weaken the mechanical strength of the bottle, especially at the corners or near the carrying handles.

With polypropylene, problems of stress cracking hardly exist. Polypropylene is a good material for difficult products. As resin prices for polypropylene worldwide are still falling, and as techniques for blowing polypropylene bottles progress, this material becomes more interesting. A biaxially oriented polypropylene bottle or an injection blown or extrusion blown random-polypropylene bottle could become an alternative to polyvinyl chloride. Because of its greater stiffness, lower specific weight, and better gloss, polypropylene might even be a good alternative to polythene. But production speed is lower due to the higher heat content of the material during conversion, and, therefore, polypropylene bottles are still more expensive.

A polythene bottle is roughly 10% less expensive than a polyvinyl chloride bottle. Whether polythene or polyvinyl chloride is chosen today is mainly a question of marketing philosophy. It depends on whether transparency, gloss, and greater stiffness are wanted or whether squeezing or possibly better impact strength are important. So one of the big detergents companies markets only certain dishwashing agents only in continental Europe in polyvinyl chloride bottles and another one uses them worldwide, while the third uses polythene bottles exclusively. Recent trends in Europe, especially France, show the extensive use of bigger polythene bottles up to 4 liters, with handles for rinse conditioners.

There is much work being done on reducing bottle weight and wall thickness by using special designs or type of polymer or compound. Optimum drop test results depend on the design of the bottom of the bottle and of the corners, or on the positioning of the handles. Computers are sometimes used today to calculate the optimum design. In Europe, generally bottle weight is at a minimum, whereas outers are strong for protection and stackability, the reason being the comparatively low cost of kraftpaper against polymer prices.

More work has gone into the design of closures than into the design of bottles for the purpose of more efficient dosing and to make them more convenient, easier to handle, or childproof. Examples are one-hand closures and, perhaps most importantly, the snip-off closure or, for childproofness, turn-squeeze or press closures. An easy, economic closure is a low density polythene snap-on cap with alufilm crimped on it.

In Argentina and Australia, concentrated dishwashing agents are marketed in sachets. As these concentrated liquids are sometimes on a nonaqueous basis, the material has to be quite sophisticated to give good seals and barrier. For aqueous liquids the soft-polyvinyl chloride sausage-type pack is well known, especially in France.

DETERGENTS PACKAGING MACHINERY

In general, there is a wide and complete range of standard, off-the-shelf machines available for every need and occasion.

The trend toward bigger powder packs in the developed countries has resulted in the development of a new generation of machines. At the same time higher speeds have been achieved. The modern machines for multi-kilo packs can erect, fill, and close at speeds of up to 60 cartons per minute. The different steps in the operation are: erection of the pre-glued carton, insertion of stiffener, riveting of the carrying handle, metering and checking weight, plus accurate metering and closing. For all carton machines it is true that the protective effect depends on proper erection and closing. Here major names of the industry include Hesser, Acma, SIG, etc. For paper or polythene sachets Transwrap type machines from various manufacturers are used.

For liquids, also in bigger bottles with carrying handles, there is a variety of filling, capping, and labeling machines available. A filling speed of 180 bottles per minute for a 750 ml polyvinyl chloride bottle with carrying handle is normal. A continuous production at this speed, of course, requires bottles of very high and uniform quality with practically no holes and uniform wall thickness.

A specific problem in filling liquid detergents is foaming, which is normally prevented by a combination of special filter designs and optimum filling temperatures, feed pressure, and filtration.

In the future it is to be expected that packaging in the detergents business will remain an important marketing tool, and its cost aspect will remain under continued scrutiny.