

Unit-dose: The answer to Indian detergent industry's sustainability challenges?

The home care industry, producing among things laundry detergents, is under considerable stress to lower its ecological impacts. Amongst the many challenges it faces on this front is the need to reduce the amount of plastics used for packaging its products. This issue has become more urgent in India in recent times, with several state governments resorting to bans on use of 'single-use' plastics, especially packaging, and indicating that more restrictions will follow in time to come.

To highlight some of the options the industry can resort to, the Indian Home and Personal Care Industry Association (IHPCIA) organised a one-day seminar on 'Concentrated laundry detergents in water soluble film for home care' in Mumbai on November 30, 2018.

Saving water, energy and plastic waste

Speaking at the inaugural session, Mr. Sanjay Trivedi, Director, IHPCIA, stressed the need for the laundry detergents industry to work in harmony



Dignitaries at the inauguration

with nature, by focussing on saving water, energy, and its packaging requirements. He pointed out that 54% of India faces high to extremely high water stress and more than 100-mn Indians live in areas of poor water quality. "Experts predict a near-crisis water situation in coming years. Industry needs to think reformulation of detergents to address the issue," he noted.

As regards plastics pollution, he pointed to the serious harm being done to the oceans and other water bodies. While as an emerging economy, India is not as sensitive to the issue, as some other developed countries are, Mr. Trivedi cautioned that the time for taking corrective action, is now. "Else governments will force the issue," he warned.

The magnitude of the plastics problem can be gauged from the fact that India consumes about 15-kt (kilotonnes) of detergent powder every day, and in the process uses 15-mn plastic bags of varying sizes. The IHPCIA is aiming to reduce use of plastics at the rate of 10% per year, to reach an overall 40% reduction of plastics use by 2022.

'Move towards concentrated liquids and unit doses'

Dwelling on formulation trends in the world, he pointed to a clear movement towards use of 'green', low-foaming surfactants based on sugar, algae- and plant-based oils. A sustainable solution gaining traction globally is the use of concentrated



Mr. Sanjay Trivedi, Director, IHPCIA

liquid detergents (CLD) packed in water-soluble film (usually made from polyvinyl alcohol, PVOH) and offered to customers as a unit-dose (more commonly referred to as detergent pods).

From a formulation perspective, these unit-dose products have several advantages including high concentration of active surfactants (up to 60%); use of non-compatible high performance ingredients each enclosed in its own separate compartment; and reduction or elimination of minerals, fillers, phosphates and zeolites.

“Concentrated laundry detergents, packed in water-soluble films, have received enthusiastic response from customers in several markets where it has been introduced so far and has garnered 17% market share in the US in just five years thanks to its benefits of consumer convenience and precise dosing,” Mr. Trivedi added. Whereas overall detergent demand grew at about 5% globally in 2016, the unit-dose market saw 11% growth in 2016 and an even more impressive 21% CAGR between 2012 and 2016.

Launched by Procter & Gamble (P&G) nearly 15 years ago, under its iconic trade name, *Tide*, unit-dose detergents are now available in several

countries from several other vendors. The complexity of the construction of these pods has also increased; recent offerings contain as many as five compartments – each having a different ingredient.

‘Price conscious Indian market ready’

The Indian market too, Mr. Trivedi felt, is also ready to take on this novel product as several factors are in its favour: ban on multi-layer packaging; space constraints in urban homes; stressed water availability; greater number of women in the workforce and hence demand for more convenient products etc. “Indian consumers are looking for value and are intelligent in their purchase decisions.”

Given the price conscious nature of the Indian market, he felt that the focus here can initially be on a single compartment unit-dose, containing about 10-ml of laundry detergent (and other ingredients), which can serve the washing needs of a family of four. Such a pod can even be used in a bucket of water, and not necessarily only in a washing machine. “Rs. 250-300 per month is a typical spend by an Indian household on laundry. Rs. 7.5 to Rs. 10 per pod is a competitive pricing for this market. The challenge is to get the polyvinyl alcohol film at as low a price as possible,” he added.

Several applications

According to Dr. Peter Richard, d-labs, a detergent development and testing solutions service provider based in Australia, while the markets for unit-doses are currently mainly focussed on laundry and dish washing applications, mostly using liquids, it is technically possible to formulate with powders and gels as well. “Hard surface cleaners and even manual dishwashing are some other application possibilities,” he noted.

For manufacturers, pods provide opportunity for higher on-shelf price and higher margins. There is also potential for adding unique, recognizable design, which is another opportunity for branding.

Formulating for pods is different from that for conventional formulations: low water content; low to no builders; high polymer levels; solvent-soluble ingredients; higher enzyme levels; higher non-ionic surfactant levels; low to no sodium salts; and extra materials required to support the film and ensure it stays stable.

“When pods were first developed their performance was slightly inferior, but that has changed over time. The technology is now very much there to deliver the performance needed,” he observed.

Formulation challenges

The key to formulating for pods is controlling water activity, as too much active water leads to a soft, unstable film, while too little leads to brittle, unstable films. “Reducing water activity impacts inclusion of other performance boosting materials as enzymes, builders etc. As solvent-soluble materials can be expensive, creativity is required to balance aesthetics, stability and performance,” Dr. Richard noted.



Dr. Peter Richard

One of the challenges with pods is incorporation of 'green' formulations, as few naturally derived solvents are commercially available and some ingredients have low solubility in 'green' solvents. Renewable surfactants such as alkyl polyglucosides (APGs) have high water content, making them difficult to incorporate into a formulation. However, fragrances can be easily incorporated; enzymes can be used without need for stabilisers; and incompatible materials (e.g. enzymes and peroxides) can be easily handled.

"Pods use for unit-dose and dilutables are likely to be the next disruptive detergent technology and a major influence on next generation detergents," Dr. Richard added.

In an Indian context a challenge can be the high demands for stain and dirt removal, which requires highly alkaline conditions – demands that are well served by powders. "This is one reason why concentrated liquids have not made a dent here in India, as would be expected based on international trends. Splitting the pod to include both – powder and liquid –

Table 1
Formulating for pods – the difference

Standard Liquid	Liquid for Pods
High water – low solvent	Low water – higher solvent
Medium builder level	Low to no builder
Low to no polymers	Higher polymer level
Water-soluble ingredients	Solvent soluble ingredients
Often high sodium/potassium salts (builder, anionic surfactant)	Low to no sodium/potassium salts (trend toward MEA/TEA)
Lower levels of enzymes	Higher enzyme levels
Lower level non-ionic surfactant	High non-ionic surfactant level
All materials used for performance	Extra materials sometimes required to support the film (e.g., polymers)

could be an opportunity to overcome the limitation."

Novel builder systems

Mr. Sudarshan Paluskar, Excel Industries Ltd., highlighted the opportunities for novel builder systems for concentrated liquid detergents and for unit-doses. According to him, India has pockets of relative affluence that could be the target areas for pods.

Excel offers an inhibitor type

phosphonate builder, which is known to inhibit hardness at all levels from 50-ppm to 1000-ppm; enhance detergency by 25-30% at very low doses; has synergy with polymers; and shows superior anti-redeposition performance. "In-house lab evaluations have demonstrated that 1-kg of this builder, offered under the brand name DETCEL-DS-11, can offer performance equivalent to 8-kg of sodium triphosphosphate (STPP).

"When hardness is controlled,

Table 2
Benefits of pods

Environmental benefits	Consumer benefits	Manufacturing Benefits
No overdosing – reduced environmental chemical load.	Compact – light for transport, small storage.	Significant reduction in packaging costs – potentially higher margin.
Significant reduction in packaging/no packaging remaining.	Simple to use.	Often higher on-shelf price – higher margin.
Reduced energy usage.	No overdosing.	Smaller batch sizes/larger number of units per batch.
Reduced water usage.	No mess.	Reduced water usage in manufacturing.
Fewer emissions from transport.	Reduced/no waste from packaging.	Reduced manpower costs.
Lower carbon footprint	Potential to purchase individual washes	Reduced manufacturing power usage (e.g., pumping water, shorter runs, smaller batch size).
	Reduced transport emissions – health effects.	Reduced warehousing space required & lower shipping costs per unit (more units per container).
		Potential for adding unique, recognisable design. Another opportunity for branding

the detergent can perform near the true CMC. Concentration of builder at 0.5-1.0% in powders and 0.25% in liquids can achieve the desired objective. This low dosage of builder is the need for compact and liquid type detergents," Mr. Paluskar noted.

According to him, this builder can be made available in a concentrated form, and can be used at half the level of the builder currently used in *Tide* pods.

'More and more shelf space in modern trade'

Mr. Balakrishnan Ramakrishnan, Regional Marketing Manager, India and Africa, Novozymes South Asia Pvt. Ltd., pointed out that unit-dose and liquid detergents are now driving the global laundry detergent market. "Liquids and powder detergents still hold major market share, but unit-dose is showing good growth. Unit-dose is now getting a lot of shelf space in modern trade, and retail is a lead indicator to future market share," he pointed out.

However, he cautioned that most transitions from powders to unit-doses have happened through concentrated liquid detergents and only in a few countries (e.g. UK) has a more direct powder to unit-dose transition taken place.

Besides the major FMCG companies (such as P&G, Unilever and Henkel),

private labels too are beginning to make a mark in unit-doses, although their share still remains small. "Unit-dose is more expensive than liquid detergent – but despite this due the convenience the reaction to their introduction has been positive. Surveys indicate that unit-doses are mostly purchased (71%) on promotion, and that 25% of consumers do their laundry 4-6 times a week."

According to Mr. Ramakrishnan, the average performance of liquid pods of two chambers is higher than the ones with only one chamber, and addition of enzymes can increase the level of performance, even in one-chamber pods. "The difference in format is not seen on cost per wash, but maybe on production cost."

Specialised machinery needed

A significant portion of the manufacturing costs of pods stems from the need for specialised machinery to handle PVOH films and reshape them in the form ultimately required with the ingredients suitably encased. PVOH films have several unique properties like stickiness, formability and memory effect, water absorption, and sensitivity to heat and moisture, which must be factored into the design and operation of the machines.

Two types machines are used for making pods:

➤ Rotary (drum) processing machine in which all functions – forming, filling, sealing and cutting – are carried out over 180°. This is the most economic build style, space saving and is relatively low cost to operate. The Cloud Hydroforma is a leading brand in this category.

➤ In linear (flat bed) machines the main processes are carried out in a linear manner. The high output machines (capable of producing 800-1,600 pods per minute) are especially well suited for complex designs and process steps. Harro Hofliger is a leading supplier in this category.

According to Mr. Fritz Major, Harro Hofliger, entry into the pods business is made difficult in EU and USA due the many patents on design, product, ingredient, process and machine style, especially by the market leader P&G. Harro Hofliger, he added, too has a strong patent position. "No machine on the market is free of risk from a patent held by P&G," Mr. Major warned.



Mr. Fritz Major

In the linear machines, forming of the PVOH film is done through a combination of heat and vacuum. Films are normally cast films (not blown), and even a little bubble can lead to a leakage. While liquid filling is easier than for powders, gel dosing is also challenging as it does not flow easily and handling requires time, which a flat type machine can provide.

Table 3
Detergent market – by type

Region	Powder	Liquid	Unit dose	Market size
North America	10.0	73.1	16.9	9,103
Central & Western Europe	29.6	49.3	21.0	9,506
Eastern Europe	79.1	12.9	8.0	3,621
Japan	23.2	65.8	10.9	2,411
Latin America	79.2	19.9	0.9	7,718
Middle East & Africa	92.8	6.7	0.5	5,940
Asia-Pacific	79.2	20.7	0.1	16,930
Australasia	53.7	44.5	1.8	546

Source: Novozymes/Euromonitor