PVC: a unique story

How one material is addressing a host of issues related to its additives

It’s hard to think of a material that has been criticised more for its use of hazardous substances than PVC. Because of its role as a major consumer of chlorine, the polymer has been a key target of Greenpeace’s for over 20 years. In 1992, for example, as chlor-alkali executives gathered at a conference in Monte Carlo to discuss the industry’s environmental issues, the Greenpeace ship Sirius sailed back and forth displaying banners proclaiming “Chlorine Kills – Ban PVC”. But global demand for PVC continued to grow, and is expected to keep growing.

Today, much of Europe’s chlorine production still uses mercury cell technology, but steady progress has been made by PVC producers and additive suppliers in Europe on many of the other issues related to PVC’s life cycle, such as increasing recycling rates and phasing out the most problematic additives. This has been driven by the sector’s VinylPlus voluntary programme, which was launched in 2000 in a (successful) bid to fend off legal restrictions on PVC from the European Commission, and which continues to be driven by pressure from Greenpeace and other NGOs, and the “halogen-free” policies of some big consumer brands (especially in the electronics sector).

For Europe’s PVC industry, the continuing focus on the plastic’s environmental record is both a curse and a boon. Although REACH does not (so far) require the registration of polymers, all of the stabilisers, plasticisers, fillers, pigments and other additives in PVC must be registered, and some of these have been added to the candidate list and are subject to authorisation or restriction, ensuring a steady drip-feed of bad news and supply chain reformulation work. But the same regulatory requirements also offer the industry a chance to rebrand today’s PVC as an example of what REACH is all about – reducing the toxicity footprint of those materials and products that are important to Europe’s economy. Speaking at the PVC2014 conference in Brighton recently, Henry Warren of IHS, a business intelligence firm, said that given the European PVC sector’s inability to compete with other regions on costs, it needs to find its niche elsewhere and “green” plastics is an area where it is taking a lead. Other goals, such as seeking ways to lower the cost of producing PVC’s main feedstocks, chlorine and ethylene, or convincing the construction industry (which accounts for 70% of the European PVC market) that PVC offers better value than other materials, are probably more important to the future health of Europe’s PVC industry, but as REACH is not going to go away, why not maximise the opportunities it offers?
remain, casts a cloud over high phthalates’ image. Commission and ECHA decided the ban on their use in toys must need not be restricted in any other products. But the fact that the DINP and DIDP (DNOP does not appear to be used anymore) the ban on three high phthalates DINP, DIDP and DNOP in toys, the Commission’s recent statement, following ECHA’s review of effects has been linked to those of low molecular weight, such as DBP, BBP and DEHP. These will be phased out under the REACH authorisation process by February 2015, except for a few uses. In response, the European plasticiser market has shifted to high molecular weight phthalates (high phthalates), such as DINP, DPHP and DIDP (see chart), even though the VinylPlus programme does not include any targets for the phase-out of low phthalates. Plasticiser producers hope high phthalates will not suffer the same fate as the low phthalates, and have highlighted the Commission’s recent statement, following ECHA’s review of the ban on three high phthalates DINP, DIDP and DNOP in toys, that DINP and DIDP (DNOP does not appear to be used anymore) need not be restricted in any other products. But the fact that the Commission and ECHA decided the ban on their use in toys must remain, casts a cloud over high phthalates’ image.

Within the phthalates family, the strongest evidence of adverse effects has been linked to those of low molecular weight, such as DBP, BBP and DEHP. These will be phased out under the REACH authorisation process by February 2015, except for a few uses. In response, the European plasticiser market has shifted to high molecular weight phthalates (high phthalates), such as DINP, DPHP and DIDP (see chart), even though the VinylPlus programme does not include any targets for the phase-out of low phthalates. Plasticiser producers hope high phthalates will not suffer the same fate as the low phthalates, and have highlighted the Commission’s recent statement, following ECHA’s review of the ban on three high phthalates DINP, DIDP and DNOP in toys, that DINP and DIDP (DNOP does not appear to be used anymore) need not be restricted in any other products. But the fact that the Commission and ECHA decided the ban on their use in toys must remain, casts a cloud over high phthalates’ image.

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In addition to the shift from low to high phthalates, the market for non-phthalate plasticisers is growing. Stéphane Content, manager of the European Council of Plasticisers and Intermediates (ECPI), says his body has a new strategy: to defend and promote all plasticisers, rather than just phthalates. ECPI’s website includes information on a dozen different types of what it calls “speciality plasticisers”, and the PVC2014 conference had a half dozen or so company presentations by non-phthalate plasticiser producers. This included a paper by Ferro on the performance of its dibenzoylate plasticiser, which says “phthalate replacement is key for the PVC industry as the end market is increasingly demanding non-phthalates”.

Stabilisers
VinylPlus has a target for the complete phase-out of lead-based stabilisers across the EU by the end of 2015. According to the European Stabiliser Producers Association (Espa), by 2013, lead stabilisers’ share of the market was down to 13%, with calcium-based stabilisers accounting for two-thirds of the market and tin and liquid mixed-metal (LMM) products making up the rest. Espa says RMM stabilisers have been “almost totally reformulated” over the last few years because of REACH and the re-classification of some of their components. All the lead stabilisers are on the candidate list, but any sunset deadline agreed under REACH authorisation would fall after the end-2015 voluntary deadline and so would be moot.

Looking ahead, VinylPlus plans to produce criteria for the “sustainable use of additives”, which will be applied to both existing additives and the development of alternatives. The criteria will cover long-term toxicity, ecological impact and their technical properties. The work of its sustainable additives task force covers around 200 widely different substances, ranging from fillers and flame retardants, to impact modifiers and lubricants, pigments, plasticisers and stabilisers.

Legacy additives
A potential barrier to recycling PVC is the presence of legacy additives – those once legitimately used when the products were put on the market, but which are now restricted - in discarded long-life products. There is a requirement under REACH to provide an extended safety data sheet for any substance or preparation containing a substance of very high concern (SVHC), and so recyclers need to know if their recyclate contains any SVHCs at a level above 0.1%w/w. EUPR, the European Plastics Recyclers Association, has produced a tool which enables recyclers to produce eSDs.

REACH also requires companies to tell end users or consumers whether their products contain any SVHCs above the 0.1% threshold, and this means firms producing products made from recycled PVC must declare that their products contain SVHCs unless they can show that they are present at levels below the threshold. But despite the lead stabiliser phase-out, recycled PVC can easily contain lead compounds above the threshold, and so if lead legacy additives are added to the authorisation list, products made from recyclate containing them could be phased out. In response, Espa and VinylPlus have commissioned a study “to model changes in the lead content of recycled PVC over the coming decades, and provide reference levels for discussion of eventual derogations, if needed.” The study is similar to that commissioned by the trade groups on cadmium levels in recycled PVC, which, says Espa, was “well

The shrinking of the DEHP market is benefiting both high phthalates and non-phthalate plasticisers
received” by the Commission and “proved decisive” in setting a maximum concentration in products, thus allowing the use of recycled PVC.

Outside Europe

ECVM is promoting its VinylPlus voluntary programme in countries such as India, Australia, South Africa and the Philippines, and some of these countries have voluntary programmes of their own. Companies signed up to the product stewardship programme of the Vinyls Council of Australia, for example, virtually eliminated their use of lead stabilisers by 2012. CEO Sophi MacMillan says that although low phthalates are not used in Australia or present in PVC products imported by its members, it would support a government ban on their use – even though Australia’s chemicals agency, Nicnas, recently said there was no need to restrict the use of the main low phthalate, DEHP. The Southern African Vinyl Association (Sava) has targets for the phase-out of lead stabilisers, cadmium additives, chromium VI pigments, bisphenol A and short-chain chlorinated paraffins, as well as for the “restriction” of DEHP.

In contrast, the US PVC industry has already dealt with most of the hazardous substances it traditionally used, says the Vinyl Institute’s Richard Krock. Virtually no PVC is produced using mercury cell technology, lead stabilisers have been largely replaced with mono-tin ones, and DEHP is only used for medical devices such as blood bags. As a result, the organisation does not need a voluntary programme in the mould of VinylPlus.

Other PVC trade bodies, however, worry that the Vinyl Institute’s lack of a voluntary programme will make it harder for the organisation to rebut any anti-PVC stories that could blow up on social media sites and spread to damage the industry in their part of the world too. At PVC2014, Ineos ChlorVinyl’s Jason Leadbitter said the Vinyl Institute was “missing an opportunity”, while Sava’s CEO, Delanie Bezuidenhout, said “we’re waiting with bated breath on your voluntary commitment. Is there a timetable?” Replying, Mr Krock said the market had already done what was needed and the institute was “not sure we’d really gain anything from it”. From the institute’s point of view, this is understandable, as it feels less need to fight its corner. Much lower feedstock costs, due to the shale gas boom, mean its economics are far healthier than those of European producers, enabling it to dominate exports markets in Africa and the Middle East. Also, it may worry that the US liability culture could open firms up to compensation claims if a voluntary programme was seen as planning actions to protect human health that they could have done before.

Other plastics?

Back in 2003, Greenpeace published a “plastics pyramid” which ranked different plastics according to their environmental and health impacts, with the worst at the top and the best forming the base. Just below PVC, which the group placed at the pyramid’s apex, stands polyurethanes, polystyrene, polycarbonate and ABS (bio-based polymers form the bottom layer). Could any of these have the misfortune to become the “next PVC”? Some polyurethane precursors are in the REACH Community Action Rolling Plan (Corap), a list of substances subject to evaluation (but not necessarily any further action). The REACH registration exemption for polymers is under review, while the durability of plastics – for so long, a positive factor – is now reflected in increasing concern about the ecological impacts of plastics waste, especially in the oceans. And the vast majority of plastics are produced from fossil fuels – an issue PVC is addressing but which there was not room to cover in this article. Will the PVC sector’s experiences in fighting to improve the material’s image prove useful to other plastics?

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As well as being used to make simple items like pipes, PVC is used in complex products such as cars