THE CASE FOR EXPANDING THE RESTRICTION ON CADMIUM AND ITS COMPOUNDS IN PLASTICS

STATUS REPORT

4 July 2013

1. Introduction to this report

The European Commission have requested ECHA to prepare an Annex XV dossier to assess whether the use of cadmium and its compounds in plastic material, other than that listed in subparagraph 1 of entry 23 of Annex XVII to REACH Regulation (EC) No 1907/2006, should be restricted.

The entry 23 of Annex XVII to REACH restricts the use of cadmium and its compounds for several uses. Concerning the restriction on plastic materials, according to paragraph 1, cadmium and its compounds shall not be used in mixtures and articles produced from the synthetic organic polymers (plastic materials) referred to in the paragraph. Currently 16 plastic materials are covered by the existing restriction. In addition, mixtures and articles produced from these plastic materials shall not be placed on the market with a concentration of cadmium equal to or greater than 0,01% by weight of the plastic material.

The restriction does not apply to articles placed on the market before 10 December 2011 and articles coloured with mixtures containing cadmium for safety reasons. In addition the restriction does not apply to articles within the meaning of Packaging Directive (Council Directive 94/62/EC) and acts adopted on its basis.

Entry 23 was amended in 2012 (Regulation (EU) No 835/2012). The amendment indicated already that by 19 November 2012 ECHA will receive a request to prepare an Annex XV restriction dossier related to cadmium and its compounds in plastics. ECHA prepared a preparatory report to describe the assessments needed in its Annex XV dossier and the uses to be investigated, based on information gathered at that time. The preliminary report (dated 9 November 2012) is published on ECHAs web site. Preliminary consultation of Member States CAs and industry associations was made together with a screening of the relevant registration data. Further information gathering was seen necessary.

The intention of this status report is to provide stakeholders with all information relating to uses that has been gathered so far in the preparation of the restriction proposal for cadmium and its compounds in plastic materials. The aim of the public consultation is to gather further information on the uses of cadmium and its compounds – in particular pigments - in plastics to have a solid basis for the proposal.

2. Background to the Commission request

Since 1988 the EU has had a common aim to substitute the use of cadmium as far as possible. The Council Resolution of 25 January 1988 on a Community action programme stresses that for cadmium control in the interest of the protection of human health and the environment should be e.g. limitation of the uses of cadmium to cases where suitable alternatives do not exist. The aim has resulted in, amongst others, restriction entry 23 of the Annex XVII of REACH Regulation (EC) No 1907/2006. The Commission has now requested ECHA to prepare an Annex XV dossier to assess whether the use of cadmium and its compounds in plastic material, other than those listed in first subparagraph of paragraph 1 of entry 23 of Annex XVII, should be restricted.

The Agency has investigated the use of cadmium and its compounds in plastic materials. Based on the information received so far, the remaining uses seem to be those that fall

under the scope of the derogation in paragraph 3, i.e. plastic articles coloured with mixtures containing cadmium for safety reasons. Some other uses have been suggested or reported, but the information received so far has not concretely identified any uses not previously known. In addition, it is proposed that the derogation in subparagraph 3 for articles placed on the market before 10 December 2011 and subparagraph 4 for packaging materials as defined by the Council Directive 94/62/EC and acts adopted on its basis should remain.

As requested by the Commission, ECHA's intention is to assess if all uses of cadmium and its compounds in plastic materials should be restricted. In its assessment ECHA will consider technical and economic feasibility of alternatives for the specific uses and considers if any proposal for derogations is justified. Information on the use of cadmium-based pigments is of particular interest to ECHA in its preparation of the Annex XV dossier. In addition, ECHA would also be interested in more concrete information related to uses considered to be important for safety reasons (benefiting from the current derogation in paragraph 3 of entry 23) and the reasons current alternatives are not sufficient.

3. Approach

ECHA received the request from the Commission on 19 November 2012 to prepare the Annex XV restriction dossier. To do this task, ECHA needs to identify the remaining uses of cadmium and its compounds in plastic materials, the technical and economical feasibility of alternatives, as well as assess the risk of cadmium and its compounds in plastic materials and of their alternatives. So far the following work has been carried out:

- Review of registration dossiers,
- Call for evidence held between 14 January and11 February 2013 and
- Investigation carried by a contractor to the Agency, starting October 2012.

A review of the registration dossiers indicated that most dossiers have not identified uses of cadmium compounds in polymers/plastics. Particular consideration to cadmium pigments was seen necessary as this function was found to be the main remaining function of cadmium and its compounds used in plastics.

ECHA launched a first call for evidence on ECHA's web site between 14 January and 11 February 2013 aiming to reach as many stakeholders as possible and thus supplement the contractor's work. Information was received from six stakeholders.

ECHA's contractor launched an on-line questionnaire in January 2013 on its website and sent out e-mail invitations to eight associations and 29 companies. In all, about 20 responses were received. Over 40 plastic companies were approached by e-mail and phone during April 2013 to try and elicit further information on the use of cadmium pigments in plastics. This resulted in a further 12 responses.

4. Summary of information gathered so far

This section contains information on:

- reported amounts of cadmium and its compounds used as pigments,
- cadmium and its compounds in plastic materials – mainly on cadmium pigments,
- the identity of cadmium pigments
- the classification and labelling of cadmium and its compounds in general and more specifically related to cadmium pigments.

Available information that ECHA has received thus far on alternatives is also included.

To define which plastics would fall under this investigation 'plastics' means those materials of headings 3901 to 3914 on the tariff and statistical nomenclature of Common Customs Tariff as estabished by Council Regulation (EEC) No 2658/87 and its Annex 1 as amended by the Commission Implementing Regulation (EU) No 927/2012 and those plastic materials without tariff code but already restricted (polybutylene terephthalate (PBT), acrylonitrile methylmethacrylate (AMMA), cross-linked polyethylene (VPA) and high-impact polystyrene).

4.1. Identity of the substances

Cadmium (CAS No 744-43-9, EC No 231-152-8) and all its compounds are within the scope of the current restriction entry 23 of Annex XVII to REACH. As the scope of the request from the Commission is to widen the restriction entry 1 to cover all plastic materials, the designation of the substance, of the group of substances or of the mixture will not be affected.

However, as the main function of cadmium and its compounds in plastics that has been identified is their use as pigments, the identification of the cadmium containing pigments has been described here.

Cadmium pigments are best known for their ability to be yellow, orange and especially, red colorants. Some examples are presented in Table 1.

Table 1

EXAMPLES OF CADMIUM PIGMENTS			
Compound (IUPAC Name)	**Colour**	**EC Number**	**CAS Number**
Cadmium sulphoselenide*	Red	261-218-1	58339-34-7
Cadmium mercury sulphide**	Red	215-717-6	1345-09-1
Cadmium sulphoselenide orange*	Orange	235-758-3	12656-57-4
Cadmium sulphide	Yellow	215-147-8	1306-23-6
Cadmium zinc sulphide yellow*	Yellow	232-466-8	8048-07-5

* These three pigments are used in the polymers (Eurocolour, 2012). ** It is unlikely that "cadmium mercury sulphide" is processed within the EU as it has not been identified by the Cadmium REACH Consortium as a substance for REACH registration (see: http://www.reach-cadmium.eu/pg_n.php?id_menu=37)

4.2. Classification and labelling

Even though the main information received on uses is on cadmium pigments, the classification and labelling information provided in this section covers cadmium as well as other cadmium compounds.

4.2.1. Classification and labelling in Annex VI of Regulation (EC) No 1272/2008 (CLP Regulation)

Cadmium and certain cadmium compounds are classified in Annex VI to Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures, part 3, table 3.1. Information on classification of certain substances is provided below.

Cadmium and cadmium oxide are classified as carcinogenic category 1B, mutagenic category 2 and reprotoxic category 2. In addition they have the following hazard class and category: Acute Tox. 2 *, STOT RE 1, Aquatic Acute 1 and Aquatic Chronic 1.

The harmonised classification for cadmium sulphide is carcinogenic category 1B, mutagenic category 2, reprotoxic category 2, STOT RE 1, Acute Tox. 4 * and Aquatic Chronic 4. It should be noted that even though cadmium sulphide is used as pigment, it has not been reported to be used as cadmium pigment in plastics (Eurocolour, 2012).

In addition cadmium compounds, with the exception of cadmium sulphoselenide (xCdS.yCdSe), reaction mass of cadmium sulphide with zinc sulphide (xCdS.yZnS), reaction mass of cadmium sulphide with mercury sulphide (xCdS.yHgS), and those specified elsewhere in the Annex VI of the CLP Regulation have a harmonised hazard class and category: Acute Tox. 4 *, Aquatic Acute 1 and Aquatic Chronic 1. However, the registration dossiers for several cadmium compounds covered by this general entry, include data indicating further health and environmental effects above and beyond those set out in the harmonised classification (e.g. for cadmium carbonate (EC Number 208-168-9, CAS Number 513-78-0) the registrants have assessed the available information as justifying Acute Tox. 2 H330; Repr. 2 H361; Muta. 2 H341; Carc. 1B H350; STOT Rep. Exp. 1 H372). The first three cadmium substances (pigments) in this entry that are under exception are subject to indusry self classification.

4.2.2. Classification and labelling in classification and labelling inventory/Industry's self classification(s) and labelling

The reported cadmium pigments in the EU (Eurocolour, 2012) do not have a harmonised classification and labelling according to the CLP Regulation. The industry self classifications for these pigments (available in the Classification and Labelling inventory) are summarised in Table 2.

Table 2

CLASSIFICATION OF IDENTIFIED PIGMENTS ACCORDING TO INDUSTRY'S SELF CLASSIFICATION (C&L INVENTORY SEARCH (12 June 2013))								
Identification	**Classification**		**Labelling**					
EC CAS Name	Hazard Class and Category Code(s)	Hazard state-ment Code(s)	Pictogram, Signal Word Code(s)	Hazard state ment Code(s)	Suppl. Hazard statement Code(s)	Specific Conc. Limits, M-factors	Notes	No of notifiers
261-218-1 58339-34-7 Cadmium sulfoselenide Red	AcuteTox. 4 AcuteTox. 4 AcuteTox. 4	H302 H312 H332	GHS07 Wng	H302 H312 H332				93
	AcuteTox. 4 Skin Irrit. 2 AcuteTox. 4 STOT SE 3	H302 H315 H332 H335		H302 H315 H332 H335				19
	Not classified							17 (joint)
235-758-3 12656-57-4 Cadmium sulfoselenide orange	Not classified							11
232-466-8 8048-07-5 Cadmium zinc sulfide yellow	Not classified							14 (joint)

For cadmium mercury sulphide red (EC number 215-717-6, CAS number 1345-09-1) there is no notification in the classification and labelling inventory (search date 12 June 2013).

4.3. Manufacture and use of cadmium and its compounds in plastics

Based on the information from the registration dossiers made by June 2013, from the call for evidence and from questionnaire, literature review and direct contacts by ECHA's contractor, the main reported use of cadmium and its compounds in plastics is the use of cadmium pigments.

The registration dossiers did not provide information in which plastic materials the pigments are used, nor the applications of the plastics containing cadmium pigment.

During the call for evidence information was received from six stakeholders. The comments were mainly related with the use of cadmium-based pigments in safety applications (see section 4.3.1.2). Additionally, one stakeholder highlighted the potential presence of cadmium in plastics produced from recycled plastic materials already containing cadmium compounds.

As mentioned earlier, the consultant received 32 responses to the questionnaire, through e-mail and via phone calls. In addition separate literature review (both academic and general literature) was conducted on the use of cadmium and its compounds in plastics.

4.3.1. Pigments

According to the most recent data (ECHA's consultation 2013), approximately 200-250 tonnes of cadmium pigments are currently placed on the EU market[1]. Assuming 65 % cadmium content in pigments, this equates to 130-160 tonnes as cadmium. About 20 % of the total volume of cadmium pigments in EU is used in plastics (ECHA's consultation, 2013).[2] Based on this information it can be estimated that around 30 tonnes of cadmium originating from cadmium pigments is used currently in plastics within EU.

The leading cadmium pigment manufacturer has informed that the cadmium pigments are used in plastics not currently restricted in the EU. However, the information identified so far is generic in use in engineering plastics (ECHA's consultation, 2013).

Cadmium is used in manufacturing pigments which are used for their:

- colouring properties (ability to perform identical colours of different pieces, ability to maintain this identity in colour under a variety of lighting, ability to create opaque colours of quality;
- stability (at the temperature, UV rays, moisture as well as enabling high processing temperatures in the production phase);
- broad spectrum of use (neutral towards the substrate, no change in mechanical properties of the substrate, no migration or release of pigment).

According to the EU RAR of 2007, three companies manufacture cadmium pigments in EU (EU-16). Since that time, one of the manufacturers has ceased its production. Both cadmium metal and cadmium oxide are used as essential raw material in the manufacturing process. In general the manufacturing process involves the preparation of a cadmium sulphate or nitrate solution; filtration to remove recoverable solids; the addition of sodium sulphide and the precipitation of chemical grade cadmium sulphide, with simultaneous additions of other salts to alter colour characteristics; filtration to define precipitate and drying; high temperature calcination to convert crystal structure to more stable form and grow to the required pigment size; further rinsing and surface treatment, milling and blending followed by extensive quality control testing to ensure compliance to pigment grade and packaging (ICdA: compilation of Industry data, 1997 as referred to in EU RAR, 2007 and communication with industry, 2013).

ICdA (2012) had no information on cadmium compounds in imported articles but suggested that the only generally used cadmium compounds were the three pigments of cadmium sulphoselenide red, cadmium zinc sulphide yellow and cadmium sulphoselenide orange.

[1] This information is corroborated by International Cadmium Association (ICdA, 2013) which has informed ECHA that in 2010 the EU produced and imported 5400 tonnes of cadmium, of which around 300 tonnes were associated with pigments in EU.

[2] According to Environment Canada (2012), over 90 % of the total volume of cadmium pigments in worldwide is used in plastics. As the restriction on cadmium and its compounds for several plastics has been in force in the EU since 1991 it would indeed be expected that the share of cadmium pigments in plastics would be lower in the EU.

4.3.1.1. Non-restricted cadmium applications

Cadmium containing pigments are used in the following polymers: low-density polyethylene for the production of coloured master batches, polystyrene acrylonitrile (SAN) and mostly in polyamides (Eurocolour, 2012).

Plastics where cadmium pigments are used include, but are not restricted to high density polyethylene (HPDE), polycarbonate, polytetrafluoroethylene (PTFE), nylon, poly acrylonitrile butadiene styrene (ABS), polymethyl methacrylate (PMMA), silicones and polypheylene oxide (PPO) (ICdA, 2012).

One pigment manufacturer has informed that cadmium is used to give colour for the following plastic materials:

- polytetrafluoroethylene (teflon) (PTFE)
- polyethylene tetrafluoroethylene (tefzel) (ETFE)
- Polyamide (PA)
- poly acrylonitrile butadiene styrene (ABS)
- Silicone (SI)
- Poly vinyl acetal resin (PVR)
- Polyamide (Nylon)
- perfluoroalkoxy acrylate (PFA)
- fluorinated ethylene propylene (FEP)
- poly vinylidene fluoride (kymar, symalite) (PVDF)
- poly etheretherketone (PEEK)
- polyphenylenesulfide (techtron, ryton) (PPS)
- polyetherimide (ulten) (PEI)
- poly amide-imide (PAI)
- polyoxymetylene (acetal) (POM)
- polystyrene acrylonitrile (SAN)
- polymetyl methacrylate (PMMA)
- Ethylene vinyl acetate (EVA)
- polyacrylic styrene acrylonitrile (ASA)
- high density polyethylene (HDPE)

The use of cadmium compounds in these plastics is currently not subject to restriction.

After consultation with industry (including ICdA, pigment manufacturers, Plastics Europe, several plastic producers etc.), and the call for evidence that ECHA made in January to February 2013 ECHA received limited information on the actual applications of these plastic materials where cadmium and its compounds might be used. One company in the EU provided more detailed information on how cadmium-based pigments are used in plastic materials. Some companies referred to the safety applications (see section 4.3.1.2).

As it was not possible to build up a comprehensive picture of the users and uses of plastics directly through the questionnaire and the call for evidence, ECHA's contractor contacted directly the producers of the coloured plastics, more specifically HDPE, ABS and PMMA producers, in order to find out whether they use cadmium pigments. For these three groups of plastics, searches were made to determine prevalence of yellow/red products and further research and/or consultation with relevant producers was used to determine whether reliance was placed on cadmium pigments. A brief summary for each group is presented below:

High-density polyethylene (HDPE) is easy to process and to manufacture and provides flexible, weatherproof, low temperature toughness (HDPE is differentiated from low-density polyethylene (LDPE) by having a density of greater than 0.94).

The area of application is very diverse and ranges from household and kitchenware, food wrapping material to uses in which a high resistance against environmental impact is of importance. This means that HDPE is the material of choice when it comes to construction products such as pipes and cable insulation but also for transport products such as pallets and crates.

ABS plastics are composed of acrylonitrile, butadiene, and styrene in varying proportions, combined by a variety of methods including graft copolymerization and physical blending. ABS plastics provide a balanced combination of mechanical toughness, wide temperature range, good dimensional stability, chemical resistance, electrical insulating properties, and ease of fabrication. ABS plastics are available as compounds for injection moulding, blow moulding, extrusion, and calendaring, as sheet for thermoforming or cold forming, and in expandable grades for foam moulding. It is worth noting that internet searches for 'red ABS' quickly reveal that a major product is filament for 3D printers. However, no information has been found to suggest that ABS filaments for 3D printers are coloured with cadmium pigments.

Polymethyl methacrylate (PMMA), a hard, rigid, and transparent plastic, is the most widely used member of the acrylic family. Trade names include Plexiglass and Altuglas. Cast PMMA sheet has excellent optical properties (it transmits more than 90% total light) and is more resistant to impact than glass. In addition to excellent optical properties, acrylics have low water absorption, good electrical resistivity, and fair tensile strength. Acrylic plastics are available as compounds for extrusion, injection moulding, blow moulding, and casting. Extruded or cast sheet and film also are marketed. Interestingly, coloured Plexiglass comes with a cadmium-free guarantee[3].

Examples of other groups of plastics which could potentially be impacted by further restrictions on cadmium pigments which have been identified through research and through consultation done by the contractor for this study are listed in Table 3.

Table 3

FURTHER EXAMPLES OF NON-RESTRICTED PLASTICS WHICH MAY USE CADMIUM PIGMENTS	
Plastic	**Comment**
PA Polyamide (Nylon)	Widely used in clothing/shoes but also widely used as an engineering plastic
Acetal (Polyoxymethylene)	Used as an engineering plastic
Fluorocarbons (including PTFE, ETFE, etc.)	Fluorocarbons have a wide range of uses from tubing (PTFE) through to construction materials (ETFE)
Polycarbonates	Noted for their strength, polycarbonates are widely used to provide a protective shell

[3] See http://www.plexiglas.de/product/plexiglas/en/about/downloads/guarantees/pages/default.asp

As for HDPE, ABS and PMMA, it would appear that although cadmium pigments may be used in such plastics, there are also alternatives. By way of example, one manufacturer had switched away from cadmium pigments in their fluorocarbon products as their customers were seeking 'cadmium-free' products. Similarly, one of the major chemical companies (Bayer) which produces polycarbonates now provides a standard 'statement of compliance' for the RoHS Directive and other legislation which confirms a cadmium content of less than 100 ppm across its polycarbonate range.

It was noted by some consultees that some plastics (such as Nylon) required high processing temperatures (300°C or more) which made it difficult to use organic pigments – as they tend to decompose at such temperatures.

4.3.1.2. Derogation for safety reasons according to entry 23 of Annex XVII

Some plastic producers are using the derogation for safety reasons (paragraph 3 of entry 23 of Annex XVII to REACH), meaning that some cadmium-based pigments are still used in the restricted plastic materials when these articles are used for safety reasons.

In 2012 ECHA conducted an investigation on the applications that may use the derogation for safety reasons[4] and examples of these applications were:

- Coloured wire insulation and cable jackets used in aircraft electrical and control systems for the purpose of fire detection and extinguishing systems, flight control systems or during flight tests.

  The wire and cable connections are often used in in a high temperature application (greater than 150 °C ambient temperature). Cadmium pigments are used to keep the colour from changing or fading over time in the high temperature. Changing/Fading of the established colour conventions could introduce a significant risk of maintenance errors, which may lead to a risk of passengers.

- Outdoor safety equipment, such as:

  - parts of rescue boats for ships (e.g. safety belts, water pockets of life rafts, canopies) and
  - parts of safety equipment for outdoor applications (e.g. seats, reels and diverse technical parts).

  Outdoor safety applications are applications used typically in outdoor activities in areas where visible colours are needed for rescue or orienteering purposes in case of emergency situations. Cadmium pigments provide highly visible colour contrast with its surroundings (e.g. in rescue situations) and where durability of the colour for the ambient environment (e.g. weather resistance, light fastness, heat resistance and chroma) is needed.

There are two safety aspects in relation to this derogation. The first relates to the use of a specific colour or pigment with certain properties which are necessary to prevent accidents. The second relates to the use of a specific colour or pigment with certain properties in

[4] See http://echa.europa.eu/documents/10162/13641/cadmium_articles_coloured_safety_reasons_201211_en.pdf

safety equipment.

It should be noted that for some applications previously claimed to be falling under the safety reason derogation, alternatives are now available and widely used (Health and Safety Executive, Department for Environment, Food and Rural Affairs, UK 2012). The following applications were reported to have used cadmium pigments but moved to alternative pigments:

- colouring underground gas pipelines vividly and durably yellow, as a safety measure to help anyone uncovering and/or disturbing service pipes identify what they have encountered;
- tinting drivers' windows on high speed trains to reduce glare (RPA, 2010); and,
- surface coatings for marine/coastguard craft or other emergency services.

Some applications which were claimed by the consultees to be articles coloured with mixtures containing cadmium for safety reasons were reported to the consultant. No information was provided if these applications uses plastics already covered by the current entry 23 or if they are made of non-restricted plastics (exept safety helmets – see information below).

Examples of 'articles coloured with mixtures containing cadmium for safety reasons' which have been identified during contractor's consultation (including pigment/masterbatch/plastics manufacturers/producers and downstream users) for this study include:

- marine buoys
- road cones
- safety barriers/chains
- fire extinguisher cabinets on trucks
- roadside bins for salt
- wiring for aircraft
- safety helmets

It should be noted that one of the UK's leading producer of safety helmets produces a wide range of brightly coloured HDPE safety helmets including red, orange and yellow ones to the highest safety standards. Discussion with this producer indicated that cadmium pigments are not used (RPA, 2013).

In addition one should note that marine buoys and wiring for aircraft were already informed to be using the derogation for safety reasons, thus using the plastic materials is already covered by the restriction entry.[5]

4.3.2. Stabilisers

Vinyl 2010 is a voluntary initiative from the PVC Industry to phase out cadmium containing stabilisers. The Voluntary Commitment was signed in 2000. The use of cadmium-based

[5] It should be noted that 'cadmium-free' cabling and wiring is required under the RoHS Directive and that many manufactures appear to be moving towards cadmium-free plastics to ensure compliance with the RoHS Directive and other legislation. Furthermore, no exemptions have been granted under the RoHS Directive on the grounds of colour for wiring or other electrical components. However, the use of wiring in aviation is exempted from the RoHS Directive as it does not apply to transport in general.

stabilisers in PVC applications made of virgin PVC has therefore completely stopped in the EU-15 since March 2001. This commitment was extended to the EU-25 as from the end of 2006 and to EU-27 in 2007. Before this phasing out, the use of cadmium-containing stabilisers, which in recent years were used only in construction profiles, had already been decreasing steadily (VITO NV, Study commissioned by Vinyl2010, 2009).

According to ICdA (2012) there is no use of cadmium compounds as stabilisers in plastics other than PVC. However, it should be noted that in EU PVC is among the 16 plastics for which restriction of cadmium and its compounds apply, only by way of derogation recovered PVC can be used with specific conditions. None of the consultees had any information on cadmium containing stabilisers in imported articles.

4.3.3. Summary of uses of cadmium and its compounds in plastics

Based on the information received the EU consumption of cadmium for cadmium pigments in plastics is estimated to be around 30 tonnes (year 2012). One of the main pigment manufacturers stated that this amount is mainly used as pigments in plastics that are not covered by entry 23 of Annex XVII. However, it should be noted that some amount is also still used for the plastics that are covered by the current restriction, but which fall under the derogation for safety reasons, as this has been reported to ECHA during the investigation conducted in 2012 (ECHA, 2012).

In summary, currently ECHA has received some information on the use of cadmium pigments in plastics, that are not yet restricted but ECHA does not have a clear picture in which plastics and for which applications the informed amount of cadmium is used in spite of several consultation phases.

4.4. Information on alternatives

There have been restrictions on the use of cadmium pigments in many plastic materials for over 20 years. This has the industry many years to develop and use alternative pigments, which most industries appear to have done.

In respect of the plastics newly specified in Regulation 494/2011[6], the affected industries may have experienced some difficulties in finding alternatives. However, the consultation carried out by ECHA suggests that alternatives are readily available – even in areas where it was possible that derogations for safety reasons could be considered. As an example one of the UK's leading manufacturers of safety helmets produces a wide range of brightly coloured HDPE safety helmets including red, orange and yellow ones to the highest safety standards. Discussion with these manufacturers indicated that cadmium pigments are not used (RPA, 2013).

Interestingly, for those producing coloured plastics which could be associated with electric and electrical equipment, many companies have switched to 'cadmium-free' pigments due to customer demands in respect of ensuring compliance with RoHS requirements[7].

Alternatives are readily available and some examples are presented in Table 4.

[6] Commission Regulation (EU) No 494/2011 of 20 May 2011 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriciton of Chemicals (REACH) as regards Annex XVII (Cadmium).
[7] Directive 2011/65/EU of the European Parliament and of the Council of 8 June on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast) (ROHS Directive).

Table 4

EXAMPLES OF ALTERNATIVES TO CADMIUM PIGMENTS FOR USE IN PLASTICS			
Name	**Colour**	**EC-Number**	**CAS-Number**
Lead sulphochromate	Yellow/Orange	215-693-7	1344-37-2
Lead chromate molybdate sulphate red	Red	235-759-9	12656-85-8
Perinone orange	Orange	224-597-4	4424-06-0
Quinophthalone yellow	Yellow	250-063-5	30125-47-4
Antimony nickel titanium oxide yellow	Yellow	232-353-3	8007-18-9
Bismuth vanadate	Yellow	237-898-0	14059-33-7
Quinacridone	Red	213-561-3	980-26-7
Sources: *RPA (2013): Support for the Preparation of an Annex XV Restriction Dossier on Cadmium, Draft Discussion Document prepared for the European Chemicals Agency, RPA, 2013.* *A comprehensive introduction to potential alternatives by colour is provided by SpecialChem, http://www.specialchem4coatings.com/tc/color-handbook/index.aspx*			

Clearly, given the very wide range of plastics and associated uses under consideration, it is not feasible to identify the 'best' candidates for alternatives to cadmium pigments for each and every plastic/application. Rather, the intention is to demonstrate that there are a range of alternatives available.

As can be seen from Table 4, there is a mixture of inorganic and organic pigments. The list includes two lead chromates but these are unlikely to be considered attractive alternatives due to their inherent toxicity and because they are among the 22 substances recommended for authorisation under REACH.

Cadmium pigments offer intense colours, excellent durability, and heat resistance during and after the processing phase. The importance of these particular attributes will vary by plastic and by application. In some cases, the heat resistance may be a key feature as the plastic processing may take place at high temperatures. In other cases, the colour brightness and/or its resistance to fading may also be important.

In some cases, changing to alternatives may lead to other unexpected consequences. By way of example, one plastics manufacturer noted that the switch from cadmium to organic pigments had led to increased quantities of residue on the process plant equipment which required additional time and resources for cleaning after production runs. Similarly, another plastics manufacturer noted that the effectiveness of rotational moulding for HDPE tanks had been impaired when moving from the use of cadmium pigments to alternatives. (RPA, 2013)

According to information received by RPA (2013) the replacing red cadmium pigments is not only the most difficult from a technical point of view but is also the most expensive with cost estimates of a 40-50% increase in pigment costs. It also suggested that alternatives

to yellow (and orange) cadmium pigments be more expensive with estimates of 10-20% increase in pigment costs.

Although alternatives to cadmium pigments may not be quite so intense and durable, it is important to note that the colour itself does not enhance the durability or performance of the associated plastic.

In addition, several respondents to the consultation undertaken by both ECHA and RPA for this study have highlighted concerns from the aviation industry. The colour of wire/cables is regulated by industry standards; colours are required to have a high thermal stability and durability as the wire/cable is often used in high temperature applications and over a timeline of several decades. Due to their physical properties the use of cadmium based pigments in such applications has been essential to ensure easy visual identification of the wires/cables within the aircraft and to ensure safe identification and handling of wires/cables during maintenance (Source: Quote taken from response to ECHA's 'Call for Evidence', February 2013).

5. Conclusions

Based on the information that ECHA has received, cadmium pigments seem to be used in the EU as colourants in plastic materials that are not currently subject to the restriction as per entry 23 of Annex XVII of the REACH Regulation[8]. Thus far ECHA has received very limited information (essentially from one EU based company) of any concrete applications of these pigments in plastics.

Contrasting this, industry has informed ECHA that about 130-160 tonnes of cadmium are currently used as pigments in the EU. About 20% of this (i.e. around 30 tonnes) is estimated to be used in plastics. Thus, while cadmium-based pigments seemed to be used, little information exists on concrete applications of these pigments.

Based on available information, ECHA currently believes that there is very limited use of cadmium as pigments for colouring plastics. An assumption can be made that the scope of the current restriction (entry 23 of Annex XVII) can be extended to cover all plastic materials without disproportionate costs in case the derogations for safety reasons to the Packaging Directive (paragraph 1 subparagraph 4 of entry 23) remain. Furthermore, specific derogations could be considered if technically and economically feasible alternatives for the use of cadmium based pigments do not exist.

6. Public consultation – questions for plastic producers and users

This public consultations is addressed to the producers of plastic materials using cadmium based pigments that are not covered under entry 23 of Annex XVII of the REACH Regulation, ECHA would like to find answers to the following questions:

1) Do you produce or use plastics which contain cadmium based pigments and which are not currently restricted under the REACH Regulation?

2) If yes, which non-restricted plastics do you produce/use, and for which applications?

[8] Some use of cadmium also seems to take place in restricted plastic materials which fall under the scope of the derogation for safety reasons.

3) Could you use other than cadmium based pigments for colouring these plastics? Would there be technical or economic implications to you or your clients if you substituted to cadmium free alternatives? Please give details.

4) Do you regard these applications as safety uses? If yes, please give details.

5) Do you produce or use non-restricted plastics which contain cadmium for any other reason? If yes, please give details.

7. References

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