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Limitations, Barriers and Standards for using Recovered Materials in Second-life Applications

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CloseWEEE

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Summary

This document defines the European and local, legal and non-legal limitations, barriers and standards associated with using recovered additives, critical minerals and metals in alternative applications. It has been produced by considering available literature and (will consider) results of surveys which are conducted as part of WP10 activities. The main conclusions to be drawn from the study are as follows:

- The European REACH regulation (reach registration evaluation authorisation and restriction of chemicals) aims to ensure a high level of protection for human health and environment. According to REACH, manufacturers, importers and downstream users have to register their chemicals and are responsible for their safety.
- For recovering substances or mixtures apply in principle the same REACH requirements as for other materials. To assess whether the recovered substance is the same as a substance that has already been registered or whether the substances are different, recovery operators need to apply the rules of the guidance on substance identification. The exemption from registration for recovered substances relies on the condition that the identical substance has been registered before.
- For recovered substances (as for other substances) containing impurities that are classified and contribute to the classification, the impurities have to be indicated.
- If impurities are components of the recycled material (independent of the percentage), the material has to be distinguished from the original material.
- Most legislation in Europe is EU led and most countries enact laws which ensure compliance with EU directives.

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Disclaimer

Contents

Tables

Figures

1 Executive Summary

1.1 Description of the deliverable content and purpose

The main goal of the CloseWEEE project is to increase the range and yield of recovered materials from WEEE streams – materials which can then be re-used for practical applications. Two important aspects of the project are:

- The recovery of additive fractions, namely Sb_2O_3 and BFR (brominated flame retardants), from the halogen rich polymer fraction produced by advanced upstream sorting and occasionally further traditional sorting techniques.
- Recovery of graphite and critical metals such as Co, Li, Cu, from WEEE Lithium-Ion batteries, through the development of an innovative process technology based on hydrothermal recovery

This document has been prepared to enable the partners involved in the separation and recovery technology development to better understand some of the requirements for re-use of the aforementioned materials from both legal and non-legal perspectives. Additionally, the document will facilitate future exploitation of the results developed as part of the project activities.

- Antimony is a rare element in the earth crust. Main global sources are in China – main product is antimony trioxide (> 130.000 MT per year), mainly used as co-additive in halogenated flame retardants in plastics, rubber and textile application.
- Antimony trioxide (ATO, Sb_2O_3) and bromine flame retardants (BFR) will be banned from consumer EEE applications in future but the recovered materials will still find intensive use in other every day products
- Global Graphite demand is increasing rapidly due to the use in batteries of electrical devices (laptops, smartphones, …). Main producer is China and prices have tripled from 2005 to now.
- The European REACH regulation (reach registration evaluation authorization and restriction of chemicals) aims to ensure a high level of protection for human health and environment. According to REACH, manufacturers, importers and downstream users to register their chemicals and are responsible for their safety.
- For recovering substances or mixtures apply in principle the same REACH requirements as for other materials. To assess whether the recovered substance is the same as a substance that has already been registered or whether the substances are different, recovery operators need to apply the rules of the guidance on substance identification. The exemption from registration for recovered substances relies on the condition that the identically substance has been registered before.
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- Most legislation in Europe is EU led and most countries enact laws which ensure compliance with EU directives.

1.2 Reference material

This document contains data from the following CloseWEEE documents:

- CloseWEEE Description of Work
- Completed Surveys - conducted in conjunction with WP10 activities.
- CLOSEWEEE-WP2-DEL-D2.1-EXERGY-2015-06-30

1.3 Abbreviation

ABS	Acrylonitrile Butadiene Styrene
ASTM	American Society for Testing and Materials
BFR	Brominated Flame Retardants
BFR-ABS	Brominated Flame Retardant Acrylonitrile Butadiene Styrene –
BFR-PS	Brominated Flame Retardant Polystyrene
BS	British Standard
CEN	European Committee for Standardisation
CENELEC	European Committee for Electrotechnical Standardisation
CFR	Chlorinated Flame Retardant
CLP	Classification, Labelling and Packaging
DoW	Description of Work
EEE	Electrical and Electronic Equipment
EIP	European Innovation Partnership
ESO	European Standardisation Organisation
EN	European Standard
ETSI	European Telecommunications Standards Institute
EU	European Union
FR	Flame Retardant
HF	Halogen Free
HFFR	Halogen Free + Flame Retardant
HIPS	High Impact Polystyrene
IET	International Electrotechnical Commission
ISO	International Organisation for Standardisation
OEM	Original Equipment Manufacturer
ODM	Original Design Manufacturer
PBB	Polybrominated Biphenyls
PBDE	Polybrominated Diphenyl ether
PC-ABS	Polycarbonate + Acrylonitrile Butadiene Styrene
PPE	Polyphenylene Ether

PPE-PS	Polyphenylene Ether + Polystyrene
PPO™	Polyphenylene Oxide (see PPE)
PFR	Phosphorous Flame Retardants
PS	Polystyrene
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RoHS	Restriction of Hazardous Substances
SDS	Safety Data Sheet
UL	Underwriters Laboratories
US	United States of America
WEEE	Waste Electrical and Electronic Equipment

2 Additives Materials Market - Production

2.1 Sb_2O_3

Antimony is a metal naturally found in the earth's crust. It is sold commercially in the form of grey, odorless pieces of metal in massive form, and occasionally in powder form. Most antimony mines are located in Asia and South-America, with China supplying over three-quarters of the world's total. In 2012 the total volume of primary antimony production was ~140,000 MT. (1)
The most commercially important compound derived from Antimony is antimony trioxide (ATO; Sb_2O_3, CAS 1309-64-4). It is manufactured via the revolatilization of crude antimony trioxide (formed via the oxidation of crude stibnite) or via the oxidation of antimony metal resulting in the formation of a white crystalline powder of a ceramic character.

Total worldwide volume of ATO production was 130,000 MT in 2013. (2)

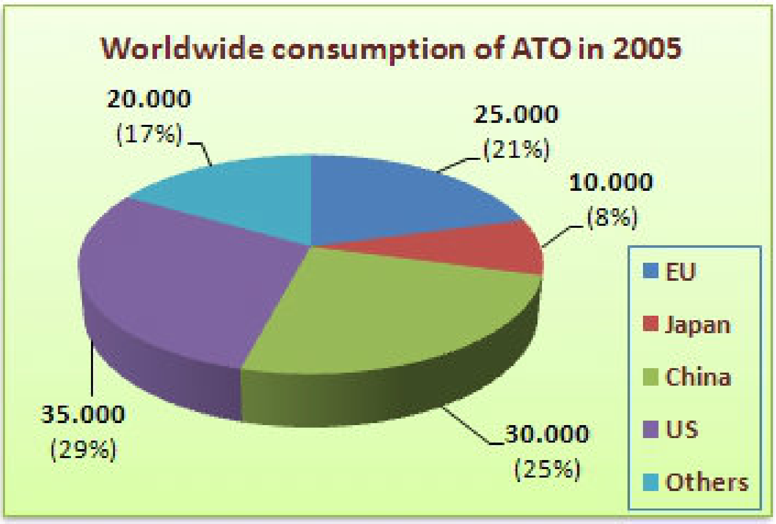


Figure 1 - Worldwide consumption of ATO in 2005 (3)

2.2 BFR

Bromine

Bromine, like chlorine, fluorine and iodine, is one of the elements in the chemical group known as halogens. The word halogen derives from Greek, meaning ‘salt-former’, because these elements are commonly found in nature, in the form of natural salts. For example, sodium chloride, or table salt, is the most common halogen salt. Bromine is abundant in nature, both in the form of bromide salts, or as organobromine compounds, which are produced by many types of living creatures on land and in the oceans.

Globally, most bromine is produced from salt brines in the United Stated and China, from the Dead Sea and Japan. Bromine is also present in certain rocks and in the earth's crust. (4)

Figure 2 - Main global Bromine sources

Bromine Flame Retardants

The worldwide consumption of flame retardants amounts to around 2 Million tons a year. According to a 2012 market study of Townsend, the consumption of flame retardants has grown substantially in the past 4 years, notably in electronics, and will continue to grow at a global annualized rate of 4-5%. Use in plastics accounts for approximately 85% of all flame retardants used with textiles and rubber products accounting for most of the rest. North America consumed the largest volume of flame retardants in 2011 with a 28% share. (5)

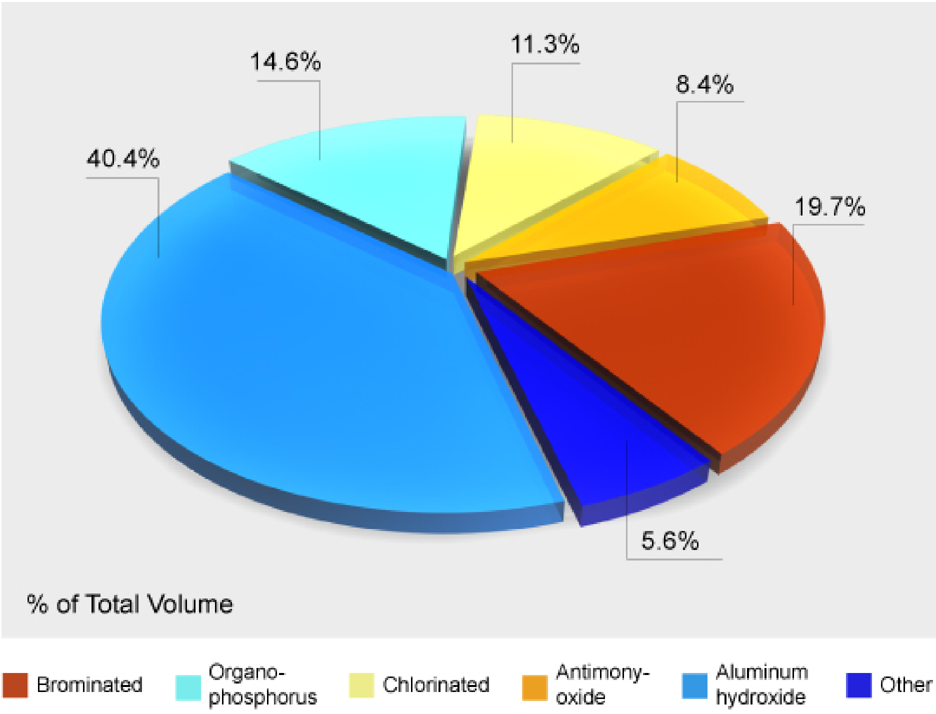


Figure 3 - Global Consumption of Flame Retardants in Plastics by Type, Tonnes (5)

2.3 Graphite

Carbon is the 15th most abundant mineral in the Earth's crust and has three forms: diamonds, coal, and graphite. Graphite comes in the form of Carbon (C) and is often denoted as Cg, with the 'g' specifying the form of carbon. Graphite is an excellent conductor of heat and electricity and has the highest natural strength and stiffness of any material known today. It maintains its strength and stability to temperatures in excess of 3,600°C. At the same time it is one of the lightest of all reinforcing agents and has high natural lubricity.

There are three types of graphite found naturally; these are flake, lump, and amorphous. Flake graphite commands the highest demand due to the versatility of use has and has yet the lowest supply. This creates a premium price for flake graphite with larger flake sizes having higher prices than a smaller flake size of equal purity.

Graphite Supply & Demand

- Graphite demand has been pinned as an approximately $12 Billion market (USD)
- Supply for graphite is generally grouped into two categories:
  - 40% of graphite supply is in flake-form
  - 60% of graphite supply is in amorphous-form
- Global consumption of natural graphite has increased from ~600,000 tons in 2000 to 1.1 M tons in 2011
  - Global graphite reserves are thought to be around 71 million tons
  - Flake graphite production is approximately 400,000 tons per year

- Demand from BRIC (Brazil, Russia, India, China) and emerging economies has been growing at about 5% per annum between 2000 - 2010, contributing to the rising price of graphite today
- China produces over 70% of the world's graphite or about 800,000 tons per year
    - Mainly low-carbon, low-value powder or small flake
    - Declining production/exports and increasing costs
    - Emphasis on value-added processing
    - Export taxes, VAT, and export licenses imposed

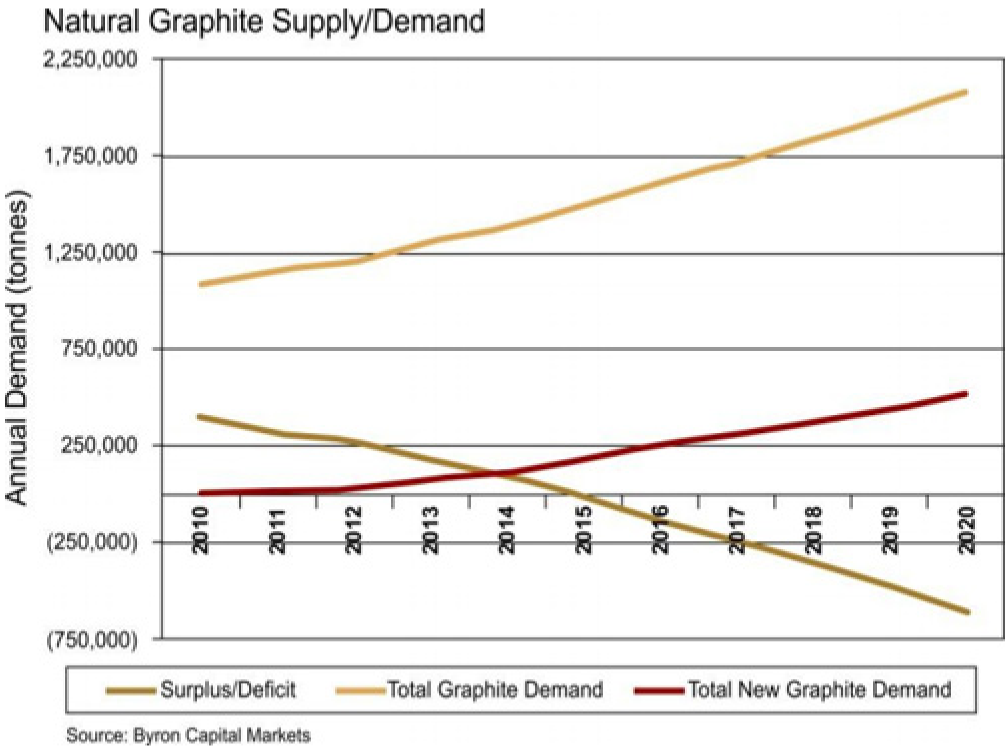


Figure 4 - Worldwide Graphite Supply and Demand

3 Additives Materials Market - Applications

Bearing in mind the target materials to be separated in the CloseWEEE project, applications have been briefly assessed to understand demand for these materials in the different applications.

3.1 Sb_2O_3

Antimony Trioxide (ATO) provides unique properties to a variety of products that cannot easily be replaced by alternative chemicals:

Increasing Fire Safety

The assessment of international safety standards since the 1980's to ensure a higher level of fire safety in houses as well as in public places (cinemas, underground trains, airplanes…) accelerated and increased the need to make inherently flammable materials fire resistant. ATO greatly increases the effectiveness of halogenated flame retardants when used as a synergist in plastics, paints, adhesives, sealants, rubber and textile back coatings.

ATO tremendously increases resource efficiency and ensures compliance with stringent fire safety standards. For example, it enables the use of certain plastics in consumer products such as computer casings and TV sets that might otherwise pose a great fire hazard.

The Leading Catalyst for Manufacture of PET Plastics

ATO is the major catalyst for the production of PET plastic used e.g. as packaging of mineral water and soft drinks. PET is one of the best materials for plastic bottles, with a history of safe use by millions of consumers every day. ATO's safe use in the production of PET bottles has been confirmed by the World Health Organisation (2003) and the European Food Safety Authority (2004). The use of ATO as a catalyst in PET bottles does NOT impact the safety of the beverages.

ATO is also used as:

- A catalyst in PET fibres and films
- Ingredient in ZnO varistors
- A clarifying aid in certain glasses
- A coating used on certain grades of TiO2 pigments
- A component in the manufacturing of complex inorganic coloured rutile pigments
- An opacifier in cast iron bath and sinking enameling (2)

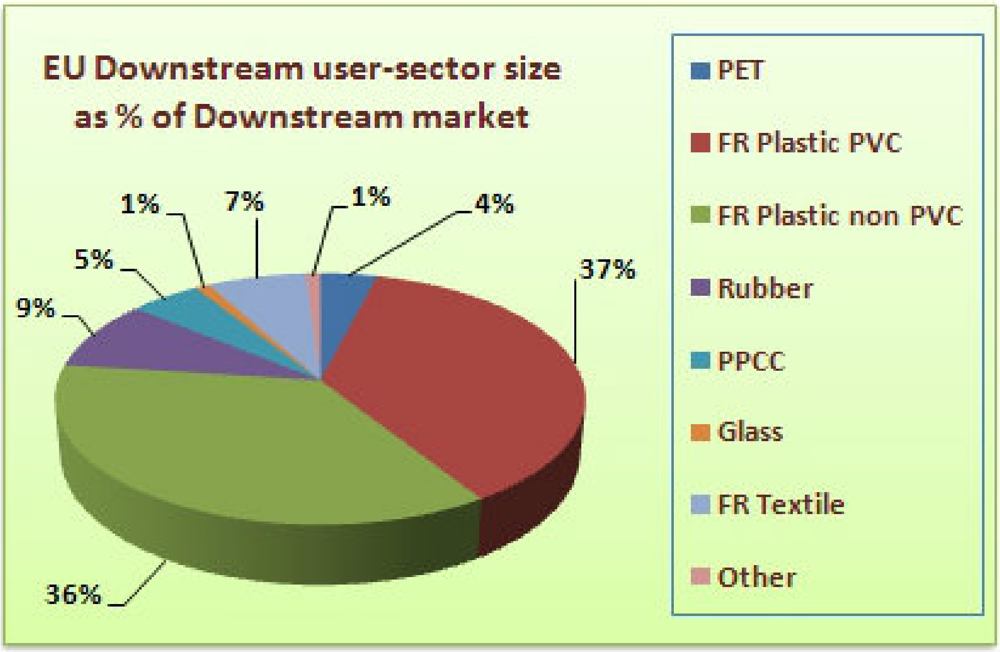


Figure 5 - ATO end user applications (3)

3.2 BFRs (Br)

3.2.1 EEE

BFRs have often previously been used in electronic products to slow down the spread of fire. Two plastic compounds which incorporate BFRs are target fractions for removal in the CloseWEEE project (BFR-ABS and BFR-PS). However, although the separation of some BFRs (PBDE, PBB) is required by RoHS there are many indications that all BFRs are being phased out from new products on the market and re-use of these compounds in new electronic products is quite infeasible.

A 2010 report by ChemSec detailed the current use and intentions of many different electrical and electronic goods manufactures with regards to the use of PVC and BFRs in their products. They noted that, even in 2010, the electronics industry had already started to replace BFR substances in their products. The following table summarises the use (2010) and intended use (2014) of BFRs in products from different organisations. (6)

Table 1 - Use and intended use of BFRs in laptops

Company	Product	Model	2010	Planned for 2014
Panasonic	Notebook/laptops	All	No data	BFR free
Toshiba	Notebook/laptops	All	Almost BFR free	BFR free
Apple	Mac Book Pro	All	BFR free	BFR free
HCI Infosystems	Notebook/laptop	ME Series 40	BFR free	BFR free
HP	Notebook/laptop	All (except below)	Almost BFR free	BFR free
HP	Notebook/laptop	ProBook 5310m	BFR free	BFR free

Acer	Notebook/laptop	All reported	Almost BFR free	Almost BFR free
Dell	Notebook/laptop	All	Almost BFR free	BFR free
Nokia	Mini-laptop	Booklet 3G	No data	BFR free
Asus	Notebook/laptop	Eee PC 900A	BFR free	BFR free
LG	Notebook/laptop	All	Almost BFR free	BFR free
Lenovo	Notebook/laptop	Notebooks	Almost BFR free	BFR free
Samsung	Notebook/laptop	Notebooks	No data	BFR free
Sony	Notebook/laptop	All reported	Almost BFR free	Almost BFR free

Table 2 - Use and intended use of BFRs in mobile phones

Company	Product	Model	2010	Planned for 2014
Panasonic	Mobile Phones	All reported	Almost BFR free	BFR free
LG	Mobile Phones	All (except below)	Almost BFR free	BFR free
LG	Mobile Phones	GD510	BFR free	BFR free
Toshiba	Mobile Phones	All reported	Almost BFR free	BFR free
Nokia	Mobile Phones	All reported	BFR free	BFR free
Sony Ericsson	Mobile Phones	All	BFR free	BFR free
Apple	Mobile Phones	All	BFR free	BFR free
Sharp	Mobile Phones	All reported	Almost BFR free	BFR free
Motorola	Mobile Phones	All (except below)	Almost BFR free	BFR free
Motorola	Mobile Phones	Motocubo A45 eco	BFR free	BFR free
Asus	Mobile Phones	P565 PDA Phone	BFR free	BFR free

Table 3 - Use and intended use of BFRs in TVs

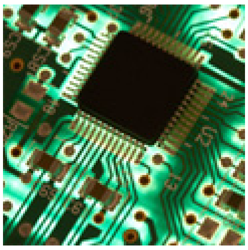
Company	Product	Model	2010	Planned for 2014
Toshiba	LCD TV	CELL REGZA 55 x	Almost BFR free	BFR free
LG	LCD TV	All (Europe)	Almost BFR free	BFR free
Samsung	LCD TV	All	No data	No data
Sharp	LCD TV	All reported	Almost BFR free	BFR free
Phillips	Flat TV	All	Almost BFR free	BFR free

In summary, there is likely to be negligible market for re-use of BFR in EEE applications as most companies are driving towards eradication of CFR and BFR compounds in their products. Plastics manufactures are unlikely to supply BFR compounds. Sabic, a market leader in plastics productions appears to no longer offer BFR (or CFR) products and instead offer other non-brominated, non-chlorinated flame retardant compounds.

3.2.2 *Other applications for BFRs*

Beside the applications mentioned under 3.2.1 BFRs are still widely used to improve the fire safety of combustible products and materials in **all sectors** of our everyday life. (7; 8)These are:

Printed circuit boards

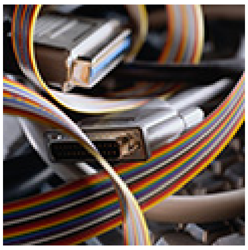


Brominated flame retardants contribute to the fire safety of all systems requiring Flame Retardant 4 (FR-4), a type of material used for making printed circuit boards. It is therefore used in a wide range of electrical and electronic equipment and installations, such as TV sets, PC, washing machines and office equipment, such as copiers, computers, printers, fax machines, radios. It is also used in high tech devices, such as, wind turbines and defence systems.

Upholstered furniture

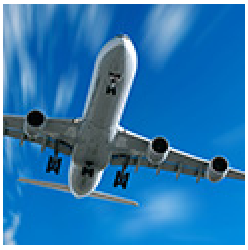
In upholstered furniture, the covering textile, the polymer (PUF) or natural foam cushions, and the moulded or rigid structure can all be fire safety treated, when required by regulations or to improve consumer safety.

Wires and cables



Electrical and optical cables are particularly susceptible to fire risks (mainly in case of electrical faults) and can represent a significant fire load and can carry fires from one place to another.

Transportation (airplanes, ships, trains, cars)

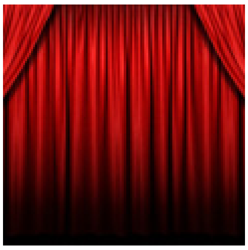


Transportation vehicles face specific fire safety issues because of the risks of accidents and the need to ensure occupants have sufficient time to escape, but seats, cables and plastic structures will burn violently and rapidly if not flame retarded.

Construction

Fire safing of insulation and decorative foams and other building materials, in particular to ensure conformity to building safety regulations.

Textiles



Both for day-to-day clothing in contexts where fire is a risk (eg. hospital linen …) and for technical fire-resistant textiles for professional uses (carpet, curtains, wall coverings…).

3.3 Graphite

Refractory Materials

Due to its high temperature stability and chemical inertness graphite is a good candidate for a refractory material. It is used in the production of refractory bricks and in the production of "Mag-carbon" refractory bricks (Mg-C.) Graphite is also used to manufacture crucibles, ladles and moulds for containing molten metals. Additionally graphite is one of the most common materials used in the production of functional refractories for the continuous casting of steel. In this application graphite flakes are mixed with alumina and zirconia and then isostatically pressed to form components such as stopper rods, subentry nozzles and ladle shrouds used in both regulating flow of molten steel and protecting against oxidation. This type of material may also be used as shielding for pyrometers.

In the production of iron, graphite blocks are used to form part of the lining of the blast furnace. Its structural strength at temperature, thermal shock resistance, high thermal conductivity, low thermal expansion and good chemical resistance are of paramount importance in this application.

The electrodes used in many electrical metallurgical furnaces are manufactured from graphite such as the electric arc furnaces used for processing steel.

Chemical Industry

There are many high temperature uses for graphite in the chemical industry such as in the production of phosphorus and calcium carbide in arc furnaces. Graphite is used as anodes in some aqueous electrolytic processes such as in the production of halogens (chlorine and fluorine.)

Nuclear Industry

High purity electrographite is used in large amounts for the production of moderator rods and reflector components in nuclear reactors. Their suitability arises from their low absorption of neutrons, high thermal conductivity and their high strength at temperature.

Electrical Applications

The main application for graphite as an electrical material is in the manufacture of carbon brushes in electric motors. In this application the performance and lifetime of the component is very dependent on grade and structure.

Mechanical Applications

Graphite is used widely as an engineering material over a variety of applications. Applications include piston rings, thrust bearings, journal bearings and vanes. Carbon based seals are used in the shafts and fuel pumps of many aircraft jet engines.

Other Applications

Amorphous graphite has applications in:

- Metallurgy
- Pencil production
- Refractories
- Coatings
- Lubricants
- Paint production

Crystalline graphite is used in:

- Batteries
- Lubricants
- Grinding wheels
- Powder metallurgy.

Flake graphite is used predominantly in refractory applications mainly in secondary steel making; in addition to this it may also be used in lubricants, powder metallurgy, pencils and coatings.

Most sources of natural graphite are also used in the fabrication of graphite foil.

Synthetic graphites are used in:

- Aerospace applications
- Batteries
- Carbon brushes
- Graphite electrodes for electric arc furnaces for metallurgical processing
- Moderator rods in nuclear power plant.

Due to its increased porosity synthetic graphite tends not be used in refractory applications.

Graphite & Green Energy Technology

Pebble Bed Nuclear Reactor

- No meltdown by design
- Lower capital and operating costs
- More efficient with the use of heat and fuel
- A 1GW Pebble Bed Reactor needs 3,000 tonnes of graphite to start up and up to 1,000 tonnes to operate annually

Lithium-Ion Batteries

- Smaller, lighter and more powerful than traditional batteries
- Li-Ion battery demand for graphite in the next 5 to 7 years will consume more graphite than is produced in total today
- Used in all types of electric vehicles with 10 - 20x more graphite than lithium used
- Only flake graphite is conducive to making Li-Ion batteries

Fuel Cells

- 80kg of graphite is used in the average fuel cell vehicle
- Fortune 500 companies are targeting fuel cell markets for non-transportation uses

4 Standardisation

Standards represent an agreed method of doing something – and they usually specify what information is required by the organisations which they represent. In this sense, it is important that the CloseWEEE activities adhere to the standards since this will facilitate up-take of e.g. produced materials.

There are several groups of standards which are important to consider for a re-use of the materials recovered in the Close-WEEE project. They are discussed in the following pages.

4.1 Materials Safety Requirements

4.1.1 Electronics Applications

BS EN 62368-1 – part 1, is the British publication of the European standard IEC 62368-1. It contains the requirements for design and manufacture of safe audio/video, information and communication technology equipment. It is nearly identical to the related European standard. (9)

As outlined in the standard, the standard is applicable to *electrical and electronic equipment within the field of audio, video, information and communication technology, and business and office machines with a rated voltage not exceeding 600V.* As such, all proposed CloseWEEE applications fall within scope of the standards.

The standard contains several clauses which are relevant to the use of plastics in new products which should potentially be considered in the developments of the CloseWEEE project.

4.1.2 Building Elements

In addition to maintaining comfortable temperatures, the use of insulation in homes, offices and public buildings is important because of the rising costs of energy and an emphasis on energy conservation and the environment.

Polystyrene foam boards and rigid polyurethane foam panels are among the insulating materials available as an accepted standard in the building and construction industry because of their performance and cost-effectiveness. While foam insulation and rigid panels allow builders to reach national and state energy efficiency requirements, they also have to conform to fire safety standards, and often, flame retardants are used to achieve these requirements.

Flame retardants in these applications help provide necessary fire-resistant characteristics, increasing the chances that individuals can evacuate a building and escape the deadly consequences of fire-related accidents.

In addition to bromine (or chlorine) compounds antimony trioxide is used as a synergist. Antimony trioxide (Sb_2O_3) itself has no flame retarding effect, but it enhances the effect (synergism) of the halogen-containing flame retardant and thus leads to a reduction of the required flame retardant amount.

The antimony trioxide reacts with the halogens. The system is cooled and furthermore these gaseous compounds protect the plastic article from oxygen.

Depending on application and country, there are various test standards and national regulations. The EU is trying to unify the standards and has published EN - standards.

Measurements on the final product have to be carried out by accredited laboratories. (9)

4.2 Materials Testing

There are certain considerations which should be made with regards to the use of recycled materials in new products. Not least, if sold on the market, there will be an expectation that these materials conform to international standards. (9)For example:

DIN EN 13501-1 (Classification Standard).

The standard describes the classification and mentions the appropriate test standard for B2 / Class E, for example, DIN EN 11925-2.

FMVSS 302 (Federal Motor Vehicle Safety Standard)

Worldwide, monitoring in the transport sector is in accordance with this standard. In Germany, DIN 75200 is used for the determination of burning behaviour of interior materials in motor vehicles. International, ISO 3795 is valid.

UL 94 V 0-5 (Tests for Flammability of Plastic Materials for Parts in Devices and Appliances)

Electronic equipment is tested mainly according to this standard. It shall not be necessary to check the finished article. A sample or a moulded part is sufficient.

5 Legislation

5.1 European Legislation

5.1.1 REACH

The European Union regulation, REACH, addresses the production and use of chemical substances and their potential impacts on both human health and the environment. All forms of recovery are applicable to REACH regulation – if the recovery results in one or more substances that have ceased to be waste after one or more of the recovery steps.

Although the REACH does not directly affect the use of recycled polymers and recovered substances it should be considered because users of the recycled polymers and recovered substances will have expectations that the recovery and upgrading of materials comply with REACH.

- Produced substances should be registered (Article 2.7.d)
- produced materials require SDS
- CLP notification required
- Restrictions and Authorisations should be complied with

Where a substance or mixture is recovered from waste and material `ceases to be waste`, REACH requirements in principle apply in the same way as to any other material with a number of conditionally granted exceptions.

A recovery operator may be able to benefit from the exemption under Article 2(7)(d) of REACH:

> *"2.7. The following shall be exempted from Titles II, V and VI:*
> *[…]*
> *(d) Substances, on their own, in mixtures or in articles, which have been registered in accordance with Title II and which are recovered in the Community if:*
> *(i) the substance that results from the recovery process is the same as the substance that has been registered in accordance with Title II; and*
> *(ii) the information required by Articles 31 or 32 relating to the substance that has been registered in accordance with Title II is available to the establishment undertaking the recovery."*

Title II = Registration, V = Downstream Users, VI = Evaluation

The recovered substance has to be the same as the already registered substance. The exemption from registration for recovered substances in Article 2(7)(d) of REACH relies on the condition that the identically substance has been registered before.

In assessing whether the recovered substance is the same as a substance that has already been registered or whether the substances are different, recovery operators need to apply the rules of the guidance on substance identification. The same EINECS and CAS numbers for substances are an indicator for the identity of substance. It should be noted that variations in the composition and the impurity profile, including a variation in the percentage of impurities, do not necessarily mean that substances are different.

It should be noted that companies willing to benefit from this exemption must provide the authorities (only on request) with appropriate documentation proving that their recovered substances qualify for the exemption.

Recovery operators will normally not receive an SDS or other safety information in the framework of Title IV of REACH. In order to benefit from the registration exemption under Article 2(7)(d) of REACH, however the required information must be available to them. Furthermore, whenever required, they need to either prepare SDSs themselves or agree with owners of existing SDSs on using those SDSs. A difference in the impurity profile may lead to a different hazard profile and therefore to distinct information to be provided to the recipient of the recovered substance. As there are no further legal provisions on this, this is a matter for the manufacturer of the recovered substance.

For recovered substances (as for other substances) containing impurities that are classified and contribute to the classification, the impurities have to be indicated. The presence of impurities as such does not itself give rise to an obligation to supply an SDS under Articles 31(1) of REACH. Such obligations may only arise through Article 31(3) requirements.

Suppliers of substances as such or in mixtures have to provide the recipient with safety information that is sufficient to allow safe use of the recovered substance.

When placing a recovered substance on the market, a recovery operator does not have to indicate a registration number, as he is exempted from the provisions of title II of REACH. However, under certain conditions as specified under Article 32(1) of REACH it may be required, if available, to provide a registration number free of charge.

The recovery operator that has the required information available for the same substance and therefore can rely on Article 2(7)(d) of REACH even if the use of a recovered substance is not covered by the registration of the same substance, is not required to:

- make an exposure scenario for the use of the recovered substance;
- register the recovered substance;
- notify the use of the recovered substance. (10) (11) (12)

5.1.2 Hazardous Substances

The Restriction of Hazardous Substances (RoHS) Directive 2011/65/EC restricts the use of six hazardous materials in the manufacture of various types of electronic and electrical equipment. It is applicable to applications proposed for CloseWEEE recycled polymers but it covers only the following materials:

- Lead (0.1 %)
- Mercury (0.1 %)
- Cadmium (0.01 %)
- Hexavalent chromium (0.1 %)
- Polybrominated biphenyls (PBB) (0.1 %)
- Polybrominated diphenyl ethers (PBDE) (0.1 %)

PBB and PBDE are BFRs and as such may be recovered through CloseWEEE technologies – but they cannot be used in new products (unless exempt).

It is important to note that the maximum permitted concentrations of these materials in non-exempt products are 0.1% or 1000ppm by weight – applicable to homogenous materials (e.g. no more than 0.1% PBB can be found in a PC-ABS blend). (13)

5.2 National

Most legislation in Europe is EU led and Europe wide since most countries enact laws which ensure compliance with EU directives. However, there are certain additional regulations which are often only applicable to specific countries (although certain similar legislation may be in existence in different countries. Usually this is coherent with European legislation. An example of the is WEEE regulations in the UK

5.2.1 WEEE regulations - UK

The Waste Electrical and Electronic Equipment Regulations do not directly affect the use of recycled polymers in new EEE (the main purpose of this report). However, it might be worth considering that there may be an expectation from users of recovered polymers that the recovered materials adhere to these regulations. The main requirement applicable to this report is that potentially hazardous BFRs, used as additives in some plastic products, are removed before or upon recycling.

Additionally, non-packaging plastics containing BFR are classified as hazardous waste and therefore The Hazardous Waste (England and Wales) Regulations Directive 2005 and The Hazardous Waste (England and Wales) Amendment Regulations 2009 are applicable. (14) (15)

6 References

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