DATA ON MANUFACTURE, IMPORT, EXPORT, USES AND RELEASES OF COBALT DICHLORIDE AS WELL AS INFORMATION ON POTENTIAL ALTERNATIVES TO ITS USE

The technical work on this report has been led by Entec, supported by BRE and IOM
under framework contract ECHA/2008/2 (specific contract ECHA/2008/02/SR5/ECA.227)

TABLE OF CONTENTS

1 INTRODUCTION 6

2 INFORMATION ON MANUFACTURE, IMPORT AND EXPORT AND RELEASES FROM MANUFACTURE. 8

2.1 MANUFACTURING SITES AND MANUFACTURING PROCESSES 8
2.1.1 Overall production volumes 8
2.1.2 Manufacturing sites 8
2.1.3 Manufacturing processes 9
2.2 IMPORT AND EXPORT OF THE SUBSTANCE ON ITS OWN OR IN PREPARATIONS 9
2.2.1 Substance on its own 9
2.2.2 Substance in preparations 9
2.3 IMPORT AND EXPORT OF ARTICLES CONTAINING THE SUBSTANCE 9
2.4 RELEASES FROM MANUFACTURE 10
2.4.1 Releases to the environment 10
2.4.2 Releases to the working environment 11

3 INFORMATION ON USES AND RELEASES FROM USES 13

3.1 IDENTIFICATION OF USES 13
3.1.1 Cobalt dichloride used as an intermediate 13
3.1.2 Cobalt dichloride used as such 13
3.2 QUANTIFICATION OF USES 14
3.2.1 Cobalt dichloride used as an intermediate 14
3.2.2 Cobalt dichloride used as such 15
3.2.3 Overall mass balance for cobalt dichloride 15
3.3 QUANTIFICATION OF RELEASES FROM USES 16
3.3.1 Releases to the environment 16
3.3.2 .Releases to the working environment 19
3.4 USES OF COBALT DICHLORIDE AND EXEMPTIONS TO INCLUSION IN ANNEX XIV 19

4 INFORMATION ON ALTERNATIVES 21

4.1 IDENTIFICATION OF ALTERNATIVE SUBSTANCES AND TECHNIQUES 21
4.2 INFORMATION ON ALTERNATIVES 21
4.2.1 Human health and environmental effects 21
4.2.2 Technical and economical feasibility and availability 21

5 REFERENCES 23

6 DISCLAIMERS 24

ANNEX 1: LIST(S) OF INFORMATION REQUIREMENTS FOR PRIORITY SETTING AND SPECIFICATION OF CONDITIONS FOR AUTHORISATION 25

ANNEX 2: CONFIDENTIAL INFORMATION 29

EXECUTIVE SUMMARY

This report presents data on the manufacture, use, releases and alternatives to cobalt dichloride (EC No 231-589-4, CAS 7646-79-9), collated by Entec. Additional support has been provided by BRE and IOM. The report has been produced according to a format and structure provided by ECHA. Draft reports have been reviewed and commented on by ECHA and this final report has been accepted by ECHA.

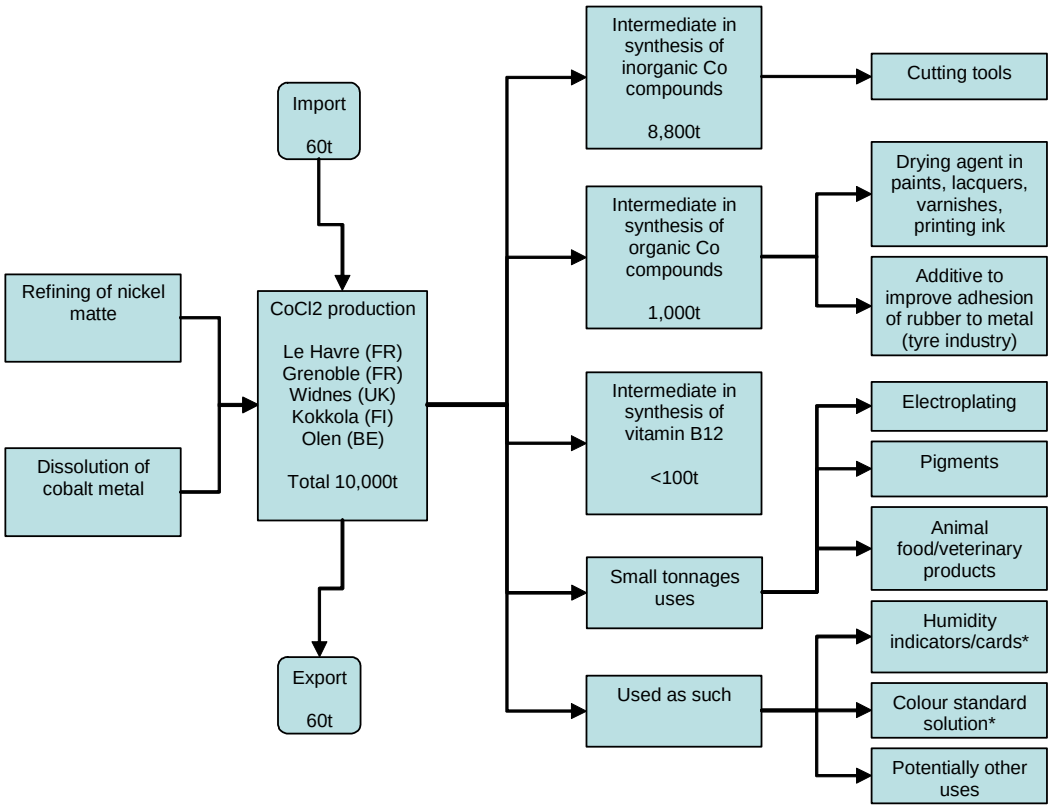
Consultation with industry indicated that the European production of cobalt dichloride amounted to 10,000t in 2007. The industry also reported that the tonnage for import was 60t and the tonnage for export was 60t in 2006. The production in the EU takes place at five sites in France (2 sites), Belgium, Finland and the United Kingdom. The main processes identified for production of cobalt dichloride are the refining of nickel matte or the dissolution of cobalt metal with hydrochloric acid.

The main use of cobalt dichloride is considered to be as an intermediate, accounting for 99% of all uses in the EU.

A total of 88% of cobalt dichloride of the total tonnage is believed to be used as an intermediate in the synthesis of other inorganic cobalt compounds (e.g. cobalt dihydroxide and cobalt oxalate). For the majority of these uses (approximately 95%), the cobalt dichloride is used as an on-site isolated intermediate. The rest is thought to be used as a transported intermediate.

A portion of 10% of the total tonnage is estimated to be used as an intermediate in the synthesis of organic cobalt compounds (i.e. cobalt carboxylates). In this case, industry considers that cobalt dichloride is either an on-site isolated intermediate or a transported isolated intermediate. Cobalt dichloride is used for this purpose either by the producer or by downstream users.

A summary of the production and uses of cobalt dichloride is presented below (Figure 3.1 in this report)



Less than 1% of the tonnage is considered to be used as an intermediate in the synthesis of vitamin B12. Small tonnages may also be used for electroplating and in the synthesis of pigments, animal food and veterinary products.

Cobalt dichloride has been identified to be used as such in humidity indicators and colour standard solutions for testing of liquids. Both uses amount to small tonnages (<1t) of the substance.

The uses of cobalt dichloride and the relevance of these uses to potential authorisation (i.e. listing on Annex XIV) are set out in Table 0.1 (Table 3.2 in the main report)

Table 0.1 Uses of cobalt dichloride and potential exemptions from Annex XIV

Use	Tonnage (t)	Downstream activities	Potential exemptions
Synthesis of inorganic Co compounds	8,800	Cutting tools *	On-site or transported isolated intermediates
Synthesis of organic Co compounds	1,000	Adhesive for tyres, drying agents in paints *	On-site or transported isolated intermediates
Synthesis of vitamin B12	<100	Vitamin B12 *	On-site or transported isolated intermediates Use in medicinal products
Manufacture of pigments	Small	Textiles *	On-site or transported isolated intermediates
Electroplating	Small	*	
Production of animal food	Small	*	Use in food or feedstuffs
Production of veterinary products	Small	*	Veterinary use
Humidity indicator cards	Confidential	Export packaging, electronic, military	Military exemptions
Colour standard solutions	Confidential	Liquid purity testing	Use in scientific research and development** Low concentration

* For these activities, cobalt dichloride is not expected to be present in the final product, but other cobalt compounds or cobalt metal.

** It is anticipated that, in some cases, this use can potentially be for research and development

Estimates of releases of cobalt dichloride from manufacture and certain uses have been provided, largely based on generic factors. Manufacture is estimated to release 45.8t and uses to the environment 101.5t (water).

Alternative substances have been identified only for humidity indicators.

1 Introduction

This report presents data on the manufacture, use, releases and alternatives to cobalt dichloride (EC No 231-589-4, CAS 7646-79-9), collated by Entec with additional support provided by BRE and IOM. This report is intended to provide ECHA with information on the substance for:

1. Priority setting of substances in the candidate list for inclusion in the Annex XIV of the REACH Regulation.
2. Defining the conditions related to the entries on Annex XIV (cf. Article 58(1)).

The report has been produced according to a format and structure provided by ECHA. Draft reports have been reviewed and commented on by ECHA and this final report has been accepted by ECHA.

The starting point for study was the Annex XV dossier submitted by the French authorities to identify cobalt dichloride as a substance of very high concern (SVHC). No additional information has been made available by the French competent authorities.

It should be noted that no comprehensive EU risk assessment or risk reduction strategy has been undertaken for cobalt dichloride. Therefore, there was little exiting information on uses, releases and alternatives that had been complied in a systematic way that could act as a starting or reference point for this study. The information presented in the present study has been collected from consultation with relevant industry organisations and trade associations. The organisations contacted are as follows:

1) The Cobalt Development Institute – CDI, (acting as a REACH consortium for cobalt, with 24 member companies, of which five have an interest in cobalt dichloride, as manufacturers or users) The CDI acted as contact for several companies and contacted potential downstream users known to them for more information. Their contribution takes into account consultation of[1]:

- Eramet
- Umicore
- OMG
- Shepherd Chemicals
- Michelin
- CEPE (European Confederation of Paint, Printing Ink and Artists' Colours Manufacturers Associations)
- CERAM-EUNIE (the European Ceramics Industries)
- CPIV (Standing Committee of the European Glass Industries)
- ECMA (European Catalysts Manufacturers Association)
- EPMA (European Powder Metallurgy Association)
- ETRMA (European Tyre and Rubber Manufacturers Association)

[1] Given the timescales for undertaking this work and the working methods agreed with the CDI, the most effective way of gathering information from these other organisations was considered to be indirectly through the CDI.

- MTA (Manufacturing Technologies Association)
- Other companies from different industry sectors (e.g. aerospace, automotive, chemicals, metals and pharmaceutical)

2) CEPE (European Confederation of Paint, Printing Ink and Artists' Colours Manufacturers Associations)
3) ZVO (Central Agency or surface treatment)
4) Celanese GmbH
5) Lilly
6) Alcon-labs
7) Hach Lange GmbH
8) Siemens
9) Specialmetal Wiggin UK Ltd

Another company was contacted but wished to remain anonymous. Details of this company can be found in the confidential annex.

2 Information on manufacture, import and export and releases from manufacture.

2.1 *Manufacturing sites and manufacturing processes*

2.1.1 Overall production volumes

The Cobalt Development Institute (CDI) is the global trade association for the cobalt industry. In 2007 the CDI created three REACH consortia which represent 24 members. When consulted[2], the CDI response involved five companies; these are understood to represent the major actors in the cobalt dichloride market in the European Union and include producers and users of the substance. The CDI also consulted other trade associations and downstream users to try and gather more information on the uses of the substance.

Four of the five companies represented in this response are manufacturers of cobalt dichloride. These companies are confident they represent a very significant proportion of the EU production and are not aware of any other manufacturers of the substance in the EU. The end of the pre-registration period and formation of SIEFs should help to identify any other potential producers, as well as importers.

These four companies estimate that, in 2007, the European production of cobalt dichloride amounted to 10,000t ($CoCl_2$ content). An estimated 99% of this production is in the form of a solution (typical concentration of 27% w/w) and 1% in crystal form (typical concentration of 54% w/w).

No information on past trends in the production, uses or releases of cobalt dichloride has been identified for this study.

2.1.2 Manufacturing sites

Cobalt dichloride is produced at five sites in the EU. Table 1.1 presents the locations of the manufacturing sites in the EU.

Table 2.1 Manufacturing sites for cobalt dichloride

Company	Country	Location
ERAMET	France	Le Havre
	France	Grenoble
Shepherd Chemicals	United Kingdom	Widnes
Umicore	Belgium	Olen
OMG	Finland	Kokkola

Source: personal communication with the Cobalt Development Institute (November, 2008)

[2] Personal communication with the CDI, October 2008.

2.1.3 Manufacturing processes

Two main processes have been identified for the manufacture of cobalt dichloride:

1. refining of nickel mattes; and
2. chemical action of hydrochloric acid on cobalt metal powder, cobalt oxide or cobalt carbonate, cobalt metal cathodes.

In the refining of nickel matte, after the matte has been prepared (crushed or grinded), a solution of nickel chloride is produced by chlorine leaching. The solution is then purified by the removal of iron then of cobalt by solvent extraction. It is further purified by extraction of metallic and organic impurities. The cobalt dichloride is therefore produced and sold as a solution. These steps take place in sealed vessels. The other process consists of dissolution of cobalt compounds in hydrochloric acid in a closed reactor to produce a solution of cobalt dichloride.[3]

2.2 *Import and export of the substance on its own or in preparations*

2.2.1 Substance on its own

Data on import and export of cobalt dichloride are available for the year 2006 only. For that year, both import into the EU and export from the EU amounted to 60 tonnes. Countries from which cobalt dichloride is imported into to the EU include the USA and far east countries such as China (including Hong Kong). Cobalt dichloride exported from the EU is destined to be used in several different countries, such as the USA, Brazil and Nigeria.

By comparison with the 2007 production and taking into account equal imports and exports, 10,000t of the substance is used in the EU annually.

2.2.2 Substance in preparations

Consultation with downstream users of the substance[4] indicated that cobalt dichloride was imported in very small quantities in preparations for use in colorimetric tests. (Further information is included in the confidential annex – Annex 2).

2.3 *Import and export of articles containing the substance*

No information is available on import and export of the substance in articles. As shown in section 3, the uses of cobalt dichloride are mainly industrial and as intermediates. It is therefore unlikely that the substance is imported to or exported from the EU in articles in significant quantities (further information is included in the confidential annex).

---

[3] These summary process descriptions are general and are based on information on the processes given by industry upon consultation. Detailed information is considered as commercially sensitive by manufacturers.

[4] Personal communication with Hach Lange GmbH, October 2008.

2.4 *Releases from manufacture*

All manufacturing sites are installations subject to Directive 2008/1/EC on integrated pollution prevention and control (IPPC). Depending upon the conditions set in individual permits, releases would be expected to be regularly monitored and it is understood that this is the case for the installations concerned[5]. However, emission data are collected for cobalt and are not specific to cobalt dichloride. It has not been possible, within the scope of this study, to contact relevant national authorities to obtain access to these data and cobalt is not a pollutant for which information on releases can be observed from the European Pollutant Emissions Register (EPER)[6].

In the absence of information on releases, estimated emissions have been calculated using the available models.

2.4.1 Releases to the environment

ECHA (2008) gives the following default emission factors for production sites (these factors assume that no risk management measures are present at the site (taken from Table R16-23)).

Air	5%
Waste water	6%

Given that cobalt dichloride as a non-volatile metal salt, the emission factor of 5% to air appears to be very high for this type of substance.

The above emission factors from ECHA (2008) are based on the highest overall generic emission factors in EC (2003). EC (2003) gives a more detailed breakdown of the emission factors, taking into account factors such as vapour pressure and amount of substance manufactured on the site. The relevant default generic emission factors from EC (2003) for production of cobalt dichloride are as shown below. As the main use of cobalt dichloride is as an intermediate in the production of other substances, the emission factors for Industry Category 3: Chemical industry: Chemicals used in synthesis have been used (Table A1.2).

Air	0%	(vapour pressure <1 Pa)
Waste water	0%	(dry process)
	0.3%	(wet process tonnage ≥1,000 tonnes/year)
	2%	(wet process tonnage <1,000 tonnes/year)

The emission factors from EC (2003) are used below to estimate the likely emissions from the sites producing cobalt dichloride in the EU (in the absence of site-specific information).

[5] Personal communication with CDI, November 2008.

[6] Possible further work for the next phase of this work could, if deemed useful, involve requesting and reviewing copies of relevant IPPC permits (and possibly publicly reported monitoring data) that would be expected to contain emission limit values for cobalt.

The total EU emission from this source can therefore be estimated as follows (details of the calculations are confidential).

Total EU	Air	0 tonnes/year
	Waste water	45.8 tonnes/year

These emission estimates have a high uncertainty as they are based on generic worst case emission factors and do not take into account any risk management measures that may be present at the sites.

It is understood that all the production sites (and hence the sites where on-site use as an intermediate also occurs) are controlled under the IPPC regime. The cobalt emissions from the sites are not reported in the European Pollutant Emission Register (EPER) dataset; however the entries for these sites in EPER do show that the emissions to water of other metals (e.g. cadmium, chromium, copper, nickel, lead and zinc) are generally <1 tonne at each site. It would be expected that any risk management measures present at these sites to reduce the emissions of these other metals would also be effective in reducing the emissions of cobalt dichloride.

2.4.2 Releases to the working environment

Cobalt dichloride is reported to be largely produced and used as a solution (99%) with only a small portion of the production and use involving cobalt dichloride in powdered form (1%).

Inhalation exposures to cobalt dichloride during the production and use of the substance in solution are likely to be negligible. Inhalation exposure may occur where the substance is produced and/or used in powdered form. Activities that may lead to exposure would include the manual packing of cobalt dichloride powder into bags or the ripping of bags and tipping of the powder into another vessel. Exposure concentrations associated with such activities can exceed 10 mg/m^3 as inhalable dust, but are dependent on the ventilation regime and other containment and control measures that may be in place. Lower levels of exposure are likely during the automated packing of powders. Typically activities such as ripping and tipping bags of powders are not undertaken continuously throughout the working day. This means that, although short term exposure concentrations may exceed 10 mg/m^3, the average exposure concentration over the entire shift will be considerably lower. For example, 15 minutes exposure to an average concentration of 10 mg/m^3 within an 8 hour shift would give rise to a shift mean exposure concentration of about 0.3 mg/m^3.

Dermal contact with cobalt dichloride could occur where either solutions or powders are handled in open systems but not where they are entirely contained in a closed system. The potential for exposure during the production and transport of cobalt dichloride would appear to be minimal. There may be a greater potential for exposure during the subsequent use of the substance. Where liquids are used in an uncontained way and there is extensive contact with a liquid or dust during the working day, the EASE model predicts an exposure of 5-15mg/cm^2/day of the liquid or dust. If in contact with the hands only, this would give an exposure of 4,200 – 12,600 mg/day or if in contact with the hands and face, this would give an exposure to 6,000-18,000

mg/day. This pattern of use seems highly unlikely, however, and a more likely scenario of intermittent handling, largely as part of a mixture, would give a predicted exposure to the liquid or dust of between 84 and 840 mg/day (hands only) or 120-12,000 mg/day (hands and face). The actual exposure to cobalt dichloride would depend on the concentration in solution if being handled as a liquid and also on the proportion of the shift over which the substance is handled. Additionally, workers are likely to use protective clothing and most handling is likely to be undertaken within contained systems. Typical levels of dermal exposure would be expected to be negligible.

There are few published data describing occupational exposure to cobalt salts. Lison et al (1994) describe workplace exposure to cobalt for workers involved in the production of salts in a refinery. Median airborne cobalt concentrations were 0.068 mg/m^3 with a reported range of 2-7.7 mg/m^3.

In a study of 82 workers at a cobalt refinery exposed to cobalt dust (metal, oxides, or salts) Swennen et al (1993) reported that the geometric mean time-weighted-average exposure assessed with personal samplers (n = 82) was about 0.125 mg/m^3 and 25% of the values were higher than 0.5 mg/m^3. No details were provided about specific exposures to cobalt salts.

Given that standards of exposure control have generally improved over the last 15 years, it would be anticipated that current levels of workplace exposure to cobalt would be much lower than reported by Lison et al and Swennen *et al*.

The UK Workplace exposure limit for cobalt and cobalt compounds is 0.1 mg/m^3 and the American Conference for Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) is 0.02 mg/m^3. Although the TLV has no legal status, it would generally be regarded as good practice to meet the TLV. UK Workplace exposure limits are normally set at levels that are believed to be achievable through good occupational hygiene practice.

Overall, it seems likely that workplace exposures to cobalt dichloride are generally low. It is technically feasible to control airborne exposure concentrations to less than 0.1 mg/m^3 and concentrations in a large proportion of workplaces handling cobalt dichloride are likely to be less than 0.02 mg/m^3. Dermal exposure to cobalt dichloride can be readily controlled through the use of appropriately designed handling systems and procedures and the use of protective clothing and gloves where appropriate.

3 Information on uses and releases from uses

3.1 *Identification of uses*

Companies involved in the CDI response indicate that the main use of cobalt dichloride is as an intermediate, accounting for 99% of all uses in the EU.

3.1.1 Cobalt dichloride used as an intermediate

A total of 88% of cobalt dichloride use is thought to be as intermediate in the synthesis of other inorganic cobalt compounds (e.g. cobalt dihydroxide, cobalt oxalate). For the majority of these uses (approximately 95%), the cobalt dichloride is used as an on-site isolated intermediate.

An estimated 10% is used as an intermediate in the synthesis of organic cobalt compounds (cobalt carboxylates). In this case, industry considers that cobalt dichloride is either an on-site isolated intermediate or a transported isolated intermediate. Cobalt dichloride is used for this purpose either by the producer or by downstream users.

Therefore, the majority of use of cobalt dichloride may be expected to be exempt from authorisation because it is intermediate use[7].

Industry indicated that less than 1% of the tonnage of cobalt dichloride is used in the synthesis of vitamin B12 and that small tonnages may also be used for electroplating and in the synthesis of pigments, animal food and veterinary products. No indicative figure has been provided to quantify these small tonnages, however, it is understood that they represent less than 1% of the total use. Furthermore, no extensive information on the processes has been gathered for these uses (other than that cobalt dichloride is not present in the final product). However, industry considers that, for the synthesis of vitamin B12 and the synthesis of pigments, cobalt dichloride is an intermediate. No information was available for animal food, veterinary products, or electroplating.

3.1.2 Cobalt dichloride used as such

Cobalt dichloride is also used as such (i.e. not used as an intermediate) in humidity indicators. Humidity indicators are designed for use in the packaging of moisture sensitive equipment, or any other humidity controlled enclosure. They readily detect changes in the humidity of the space being monitored by a colour change indicator which turns from blue to pink as the humidity increases (and turns back to blue when the humidity decreases). It is of particular use for electronic or electro-optic equipment.

Consultation with industry[4] indicated that cobalt dichloride is also used for the preparation of platinum-cobalt standards used in the Hazen or APHA method for colour measurement in liquids. The standard solution is either used for visual

[7] The decision on intermediate use is the responsibility of ECHA and the Commission

comparison to the liquid being tested or more often used to calibrate or verify the calibration of instrumental methods. Consequently, the quantity of cobalt dichloride used is very small. This method is a universally regarded standard method for the determination of colour in liquids, most specifically colour in water. Alternative standards, the Gardner colour standards, are used widely for the measurement of colour in other liquids such as oil, paints and varnishes. These standards also use cobalt dichloride in small quantities.

No other uses of cobalt dichloride have been identified for this study, although other minor uses may exist.

3.2 *Quantification of uses*

3.2.1 Cobalt dichloride used as an intermediate

Based on the total figure of 10,000t of cobalt dichloride used in the EU in 2007, the 99% that is used as an intermediate amounts to 9,900t.

In order to understand the activities involved in the downstream market for cobalt dichloride, information has been gathered on the downstream uses of cobalt compounds synthesised from cobalt dichloride.

An estimated 8,800t (88%) of cobalt dichloride are used in the synthesis of inorganic cobalt compounds (e.g. cobalt hydroxide or cobalt oxalate). These salts are then reduced using hydrogen into cobalt metal powders. These powders are used to prepare cutting tools, such as cemented carbide and diamond tools. The former is predominantly used for cutting metal, while the latter are used for cutting stone, concrete and minerals.

Industry indicated that 95% of this 8,800t (i.e. 8,360t) are used as an on-site isolated intermediate. Therefore, the vast majority of that use is considered to take place at production sites.

An estimated 1,000t (10%) is used in the synthesis of cobalt carboxylates. These compounds can be used as rubber adhesion additives in radial tyres to improve the bonding of the rubber compounds onto the brass-plated steel cable. In that case, only small additions (<0.5%) are required. Cobalt carboxylates with slightly different organic ligands are used to accelerate drying of oil-based paints, varnishes and inks. They act as an accelerator of the oxidation of the oil and catalysts for polymerisation. The films (of paint, varnish or ink) formed have then increased stability, resistance and flexibility.

Industry indicated that this use cobalt dichloride is either an on-site or a transported isolated intermediate, for use either by the producer or a downstream user. Michelin has been identified as a major downstream user and has been involved in the response from the CDI (this is the only downstream user amongst the five companies represented by the CDI's response, the remainder being producers). Michelin has 39 production sites across eight EU countries, nearly half of the sites being located in

France[8]. However, it is not clear if cobalt dichloride is processed on each site. No information on the geographical distribution of the use cobalt dichloride by the paint industry has been identified for this study.

The main downstream industries using of cobalt dichloride as an intermediate are the tyre manufacturing industry, manufacturers of cutting tools, paints, varnish and ink manufacturers, vitamin B12 production, manufacture of pigments for textile and production of veterinary products. Although the tonnage for the use of cobalt dichloride in electroplating is not known, consultation with industry revealed that research is being carried out on the use of cobalt salts (and particularly cobalt dichloride) in electro-deposition processes in the aerospace and automotive sectors. This research aims at reducing chromium (VI) electroplating by promoting use of cobalt salts. Hence, depending on the results of the research, electroplating could represent an increasing use of cobalt dichloride[9].

3.2.2 Cobalt dichloride used as such

Humidity indicators appear to be sold across the entire EU. A manufacturer of humidity indicator cards has provided some confidential data on the quantities of cobalt dichloride used in the products (see the confidential annex).

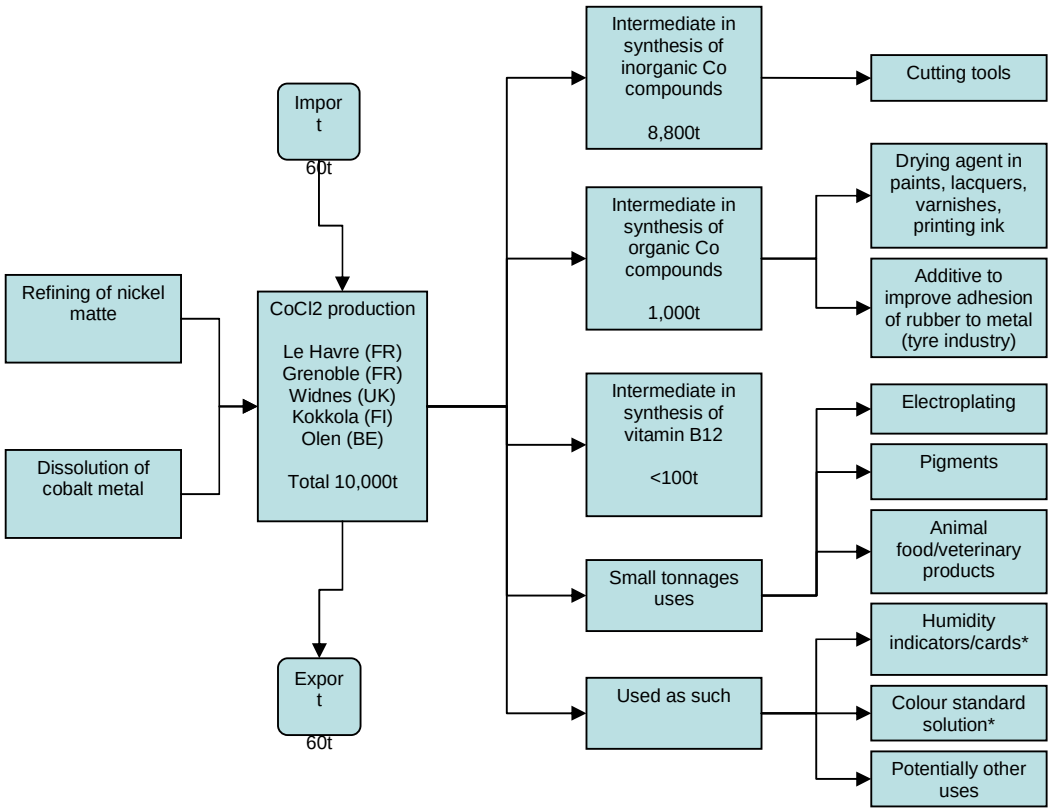
The confidential annex also presents the tonnages of cobalt dichloride involved in the colour standard solutions. These solutions are often quite diluted (the concentration is less than to 0.01% of cobalt dichloride).

3.2.3 Overall mass balance for cobalt dichloride

Figure 3.1 presents the production, import, export and uses of cobalt dichloride.

[8] http://www.michelin.com/corporate/front/templates/affich.jsp?codeRubrique=12&lang=EN
[9] This is mentioned as an alternative in the sodium dichromate study for ECHA

Figure 3.1 Summary of production and uses for cobalt dichloride



* tonnages available in the confidential annex

3.3 *Quantification of releases from uses*

No information was available on releases from the uses of cobalt dichloride. Below are presented estimates for the major uses identified, i.e. as an intermediate.

3.3.1 Releases to the environment

Use as an intermediate – production of inorganic cobalt compounds

Around 88% of the total use of cobalt dichloride is in the production of inorganic cobalt compounds. The cobalt dichloride is used as a solution and hence the process is a wet process.

Based on a total EU tonnage of 10,000 tonnes, the amount of cobalt dichloride used in this application in the EU is around 8,800tpa. Around 95% of this amount (~8,360 tonnes/year) is used as an on-site isolated intermediate and so, in this case, the emissions from this process will occur at the same locations as the production sites. The remaining tonnage (~440 tonnes/year) in this application is assumed to be used as an off-site intermediate.

ECHA (2008) gives the following default emission factors for use of a substance as an intermediate (these factors assume that no risk management measures are present at the site (taken from Table R16-23).

Air	5%
Waste water	2%

As was the case for production, the emission factor of 5% to air appears to be very high for this type of substance and so the default generic emission factors from EC (2003) will be used here. The relevant default generic emission factors from EC (2003) for use as an intermediate are as follows (Table A3.3).

Air	0-0.001%	(vapour pressure <1 Pa)
Waste water	0%	(dry process)
	0.7%	(wet process tonnage ≥1,000 tonnes/year)
	2%	(wet process tonnage <1,000 tonnes/year)

The emission factors from EC (2003) are used below to estimate the likely emissions during processing from the sites producing cobalt dichloride (on-site users of the substance) in the EU.

The amount of cobalt dichloride used for on-site use as an intermediate is estimated to be around 8,360tpa. The remaining tonnage (~ 440 tonnes/year) of the cobalt dichloride used in this application is used as an off-site intermediate.

The following emission estimates can be obtained for use as an intermediate, assuming the cobalt dichloride is used in a wet process (details of the calculation are confidential). It should be noted that the emissions for on-site use will occur at the same locations as the production sites considered in Section 2.4.1.

The total EU emission from this source is summarised below.

Total EU emission	Air	0-0.088 tonnes/year
	Waste water	79.5 tonnes/year

These emission estimates are based on generic worst case emission factors and do not take into account any risk management measures that may be present at the sites.

Use as an intermediate – production of organic cobalt compounds

Around 10% of the total cobalt dichloride use (i.e. around 1,000 tonnes/year) is used as an intermediate in the synthesis of organic cobalt compounds. The cobalt dichloride is used as a solution and so a wet process is assumed.

Using the same approach as above for use as an intermediate for the production of inorganic cobalt compounds, the emissions from this source are estimated using the generic default emission factors from EC (2003) (Table A3.3). These are summarised below.

Air	0-0.001%	(vapour pressure <1 Pa)

Waste water	0%	(dry process)
	0.7%	(wet process tonnage ≥1,000 tonnes/year)
	2%	(wet process tonnage <1,000 tonnes/year)

The total EU emissions estimated using these factors are summarised below (assuming a wet process and that <1,000 tonnes are used on a site).

Total EU emission	Air	0-0.01 tonnes/year
	Waste water	20 tonnes/year

These emission estimates are based on generic worst case emission factors and do not take into account any risk management measures that may be present at the sites.

Use as an intermediate in the synthesis of vitamin B12

The amount of cobalt dichloride used in this application is <1% of the total EU use (i.e. <100 tonnes/year). It is understood that vitamin B12 is manufactured by microbial fermentation (Scott, 1998) and hence can be considered a wet process.

Assuming a maximum of 100 tonnes/year are used per year in the EU in this application and the same emission factors from EC (2003) as used as above for use as an intermediate in production of organic cobalt compounds, the following total EU emissions can be estimated.

Total EU emission	Air	0-0.001 tonnes/year
	Waste water	2 tonnes/year

These emission estimates are based on generic worst case emission factors and do not take into account any risk management measures that may be present at the sites.

Summary of total release estimates

The total release for the use cobalt dichloride estimated to occur to the EU environment is summarised in Table 3.1 below.

Table 3.1 Estimated emissions to the EU environment corresponding to the use of cobalt dichloride

Use	Estimated emissions (tpa)	
	Air	Waste water
Production of inorganic Co compounds	0 – 0.088	79.5
Production of organic Co compounds	0 – 0.01	20
Synthesis of vitamin B12	0 – 0.001	2
Total	**0 – 0.1**	**101.5**

These emission estimates are based on generic worst case emission factors and do not take into account any risk management measures that may be present at the sites. Therefore, they are presented here for information only and have not been included in the above mass balance.

As no consumer use of the substance has been identified in this study, no releases are expected for that kind of use

3.3.2 .Releases to the working environment

Releases to the working environment from use of cobalt dichloride are considered together with releases from production in section 2.4.2.

3.4 *Uses of cobalt dichloride and exemptions to inclusion in Annex XIV*

Based on the information available for this study, it is felt that some of the uses identified could be considered as being subject to exemptions from the authorisation procedure.

Table 3.2 presents a summary of the uses of cobalt dichloride, of the tonnages involved and of the downstream activities, along with the potential justifications for exemption from Annex XIV.

Table 3.2 Uses of cobalt dichloride and potential exemptions from Annex XIV

Use	Tonnage (t)	Downstream activities	Potential exemptions
Synthesis of inorganic Co compounds	8,800	Cutting tools *	On-site or transported isolated intermediates
Synthesis of organic Co compounds	1,000	Adhesive for tyres, drying agents in paints *	On-site or transported isolated intermediates
Synthesis of vitamin B12	<100	Vitamin B12 *	On-site or transported isolated intermediates Use in medicinal products
Manufacture of pigments	Small	Textiles *	On-site or transported isolated intermediates
Electroplating	Small	*	
Production of animal food	Small	*	Use in food or feedstuffs
Production of veterinary products	Small	*	Veterinary use
Humidity indicator cards	Confidential	Export packaging, electronic, military	Military exemptions
Colour standard solutions	Confidential	Liquid purity testing	Use in scientific research and development** Low concentration

* For these activities, cobalt dichloride is not expected to be present in the final product, but other cobalt compounds or cobalt metal.

** It is anticipated that, in some cases, this use can potentially be for research and development

4 Information on alternatives

4.1 *Identification of alternative substances and techniques*

As 99% of cobalt dichloride produced is used as an intermediate no alternative substances or techniques have been identified for this use. Given this, no consideration has been given to alternatives to downstream products.

Alternatives have been identified to cobalt dichloride when it is used as a humidity indicator. The Annex XV dossier issued by France identified the use of other metal salts, such as iron or copper salts, as alternatives. However, consultation with industry[10] indicated that alternatives to cobalt dichloride provide a sufficient range of humidity indication and therefore these substances were not considered to be technically suitable.

Other consultation (see the confidential annex) indicated that the quality and performance requirements for humidity indicator cards were defined in industry specifications, e.g. MIL-I-8835A (military specifications), J-STD-033B, TL 6685-0003 and DIN 55473. According to industry, the only alternative substance identified so far allowing humidity indicator cards to fulfil all quality and performance requirements of these specifications is cobalt bromide.

Cobalt-free humidity indicators are advertised by manufacturers[11], but these products were not investigated further for this study, recognising that this use represents a small portion of the total tonnage.

No alternative substances or techniques to cobalt dichloride have been identified for the other uses.

The French competent authorities are undertaking a study aiming at identifying alternative solutions to the use of some substances classified as CMR. When published, this study might give indications of possible alternative substances and techniques to the use of cobalt dichloride.

4.2 *Information on alternatives*

4.2.1 Human health and environmental effects

No information is provided here because no suitable alternatives have been identified.

4.2.2 Technical and economical feasibility and availability

According to one humidity indicator card manufacturer, all identified alternatives to cobalt chloride containing humidity indicator cards are about 30% to 500% more expensive than those containing cobalt dichloride.

[10] personal communication with Siemens AG, October 2008
[11] for instance http://www.levosil.com/english/indicatori-di-umidita.php

No information is provided here for other uses because no suitable alternatives have been identified.

5 References

EC (2003). Technical Guidance Document in support of Commission Directive 93/67/EEC on Risk Assessment for new notified substances, Commission Regulation (EC) No 1488/94 on Risk Assessment for existing substances and Directive 98/8/EC of the European Parliament and of the Council concerning the placing of biocidal products in the market. EUR 20418 EN, European Commission, Joint Research Centre.

ECHA (2008). Guidance on Information Requirements and Chemical Safety Assessment. Chapter R.16: Environmental Exposure Estimation. European Chemicals Agency.

Lison D, Buchet JP, Swennen B, Molders J, Lauwerys R. Biological monitoring of workers exposed to cobalt metal, salt, oxides, and hard metal dust. Occup Environ Med. 1994 Jul;51(7):447-50.

Scott J.W. (1998). Vitamins (B_{12}). Kirk-Othmer Encyclopedia of Chemical Technology. Fourth Edition, Volume 25, pp 193-217.

Swennen B, Buchet JP, Stánescu D, Lison D, Lauwerys R. Epidemiological survey of workers exposed to cobalt oxides, cobalt salts, and cobalt metal. Br J Ind Med. 1993 Sep;50(9):835-42.

6 Disclaimers

Third Party Disclaimer

Any disclosure of this report to a third party is subject to this disclaimer. The report was prepared at the instruction of, and for use by ECHA. It does not in any way constitute advice to any third party who is able to access it by any means. Entec excludes to the fullest extent lawfully permitted all liability whatsoever for any loss or damage howsoever arising from reliance on the contents of this report. We do not however exclude our liability (if any) for personal injury or death resulting from our negligence, for fraud or any other matter in relation to which we cannot legally exclude liability.

Annex 1: List(s) of information requirements for priority setting and specification of conditions for authorisation

Table 1: Overview on manufacture, import, export

Manufacture, trade and formation	**Process** (narrative description)	**Locations** (number of M sites; spatial distribution) [2]	**Tonnage manufactured, imported, exported or formed**	**Releases to working environment** [3]	**Releases to environment** (t/y released to air, wastewater or to waste)
Manufacture EU Process A	Refining of nickel matte	5 sites Le Havre (FR) Grenoble (FR) Olen (BE) Kokkola (FI) Widnes (UK)	unknown	breakdown unknown	breakdown unknown
Manufacture EU Process B	Dissolution of Co metal in HCl – intermediate in synthesis of inorganic Co compound		unknown		
Total Manufacture			**10,000t in 2007 (CDI)**	**only exposure has been estimated (see section 2.4.2)**	**45.8tpa ****
Import subst. on its own			60t in 2006 (CDI)		
Import subst. in preparations			Small (see confidential annex)		
Import subst. in articles [2]			Confidential annex		
Import into EU (total)			**60t**		
Export subst. on its own			60t in 2006 (CDI)		
Export subst. in preparations			unknown		
Export subst. in articles [1]			unknown		
Export from EU (total)			**60t**		
Global manufacture			unknown		
Unintentional formation during incineration (EU)	Unknown or N/A				
Unintentional formation in processes (EU)	Unknown or N/A*			t/y	t/y

Manufacture, trade and formation	**Process** (narrative description)	**Locations** (number of M sites; spatial distribution) [2]	**Tonnage manufactured, imported, exported or formed**	**Releases to working environment** [3]	**Releases to environment** (t/y released to air, wastewater or to waste)
Unintentional formation by transformation/degradation (EU)	Unknown or N/A				
Total unintentional formation (EU)				∑ t/y; uncertainty; trends	∑ t/y; uncertainty; trends

1 A list of article types in which the substance is included shall be provided in addition.

2 In quantitative or geographical terms exact specifications are only required if the number of sites is low. If there are many sites a semi-quantitative or qualitative description of the manufacturing structure and spatial distribution of manufacturing sites (e.g. in which Member States, regions, etc.) may suffice.

3 In case a quantification of releases is not possible a qualitative description of the emission situation at the workplace(s) shall be given and a semi-quantitative estimate of the exposure situation provided (e.g. no exposure – very high exp.).

* In the process of refining nickel matte, the formation of cobalt dichloride can be considered as unintentional. However, it is well known and is apparently controlled.

** These emissions are estimates only and are expected to be high as they are based on a conservative approach

Table 2: Overview on uses in formulations or in end uses

Uses	**Use Process** (description: narrative and by use descriptor system)	**Amount used** (t/y)	**Number of sites of use** [1] (#)	**Spatial distribution of emission sites** [1]	**Releases to working environment** [3]	**Releases to environment** (t/y released to air, wastewater or to waste)
Formulation						
Humidity indicator cards		Confidential annex	Potentially wide use	unknown	unknown	unknown
Colour standard solution	Hazen/Gardner method, solutions concentration <0.01%	Confidential annex	Potentially wide use	unknown	unknown	unknown
∑ Formulation		Confidential annex	unknown	unknown	unknown	unknown
End uses						
End Use 1						
End Use 2						
……..						
End Use *n*						
∑ End Uses		∑ t/y; uncertainty; trends	∑#, trend	Overall geographical pattern; trend	∑ t/y; uncertainty; trends	∑ t/y; uncertainty; trends
Consumer use						
Substance in articles [2]						
Substance in preparations						
∑ consumer use of subst. in articles and preparations		∑ t/y; uncertainty; trends				∑ t/y; uncertainty; trends

1 In quantitative or geographical terms exact specifications are only required if the number of sites is low. If there are many sites a semi-quantitative or qualitative description of the use structure and spatial distribution of sites of release (e.g. in which Member States, regions, etc.) may suffice.

2 A list of article types with the substance included and used by consumers shall be provided as well.

3 In case a quantification of releases is not possible a qualitative description of the emission situation at the workplace(s) shall be given and a semi-quantitative estimate of the exposure situation provided (e.g. no exposure – very high exp.).

Table 3: Overview of quantitative information requested at Member State level for individual years.

YEAR n	**Manufacturing** (t/y)	**Manufacturing** # sites	**Formulation** (t/y)	**Formulation** # sites	**Use 1** (t/y)	**Use 1** # sites	**Use n** (t/y)	**Use n** # sites
Member state								
Austria								
Belgium								
…								
Total								

YEAR n+1	**Manufacturing** (t/y)	**Manufacturing** # sites	**Formulation** (t/y)	**Formulation** # sites	**Use 1** (t/y)	**Use 1** # sites	**Use n** (t/y)	**Use n** # sites
Member state								
Austria								
Belgium								
…								
Total								

ANNEX 2: CONFIDENTIAL INFORMATION