

## REACH for catalysts

### 1. Introduction

Catalyst use normally involves complex interactions within the reactor, sometimes creating new chemical substances during their life cycle, which may have regulatory implications under REACH and/or waste regulations. In order to better define what some of these regulatory obligations may be, Catalysts Europe have prepared this document as a reference to help catalyst users assess their particular manufacturing process with respect to these regulations.

It is implicit that each catalyst user has a unique obligation to examine each of their catalyst processes to determine:

- If any substances may be formed in the reactor on or in the catalyst
- If they remain in the process streams leaving the reactor and are subsequently isolated
- If they remain in the reactor and are subsequently discharged with the spent catalyst.

The catalyst itself is another potential source of new substances with potential regulatory impact.

All the steps presented below are summarised in an example based on hydroprocessing catalyst in Figure 1.

### 2. Fresh catalysts

Most catalysts are generally considered to be “mixtures”, consisting of a number of chemical substances. The individual substances in fresh catalysts must be REACH Registered. The Registrant can be the catalyst manufacturer, the importer or the Only Representative. Depending on the assessment of the Registrant, some catalyst components (substances) may be considered as being “transported isolated intermediates” (Art.18.4.).

### 3. Active catalysts

Most catalysts must be activated before use. This involves chemical reactions, creating **new chemical substances that are considered to be “manufactured” under REACH** and that must be registered by the facility at which these reactions occur if they do not meet the definition of non-isolated intermediates. There could be exceptions to this as described in the section on spent catalysts below.



Hydroprocessing catalysts are activated which means the metal oxides in the fresh catalyst must be reduced, usually by introducing sulfur to convert the metal oxides into metal sulfides.

- a. If this activation occurs in the reactor at the customer's site (in-situ), the metal sulfides formed are considered to be "manufactured" by the customer and the assessment of these substances will most certainly lead to a characterization of them as non-isolated intermediates, thus exempt from REACH (Art.2.1 (c)). The next step in the assessment will be spent catalyst as described in the section below.
- b. If this activation occurs before the catalyst is delivered to the customer (ex-situ) in a process called "pre-sulfiding", the metal sulfides are considered to be "manufactured" by the facility that performs this process and that facility must register the metal sulfides under REACH.

## 4. Spent catalysts

Spent catalysts are "manufactured" at the refineries or chemical plants. The physical properties of spent catalysts as well as their composition are generally different from the fresh catalysts. For example, spent refinery hydroprocessing catalysts are typically self-heating, contain metal sulfides and coke and may have additional substances such as contaminants deposited during service that were not present in the fresh catalyst. These substances may contribute to the hazards of the spent catalyst such as vanadium, arsenic and iron.

The spent catalyst is either treated in the reactor where the metal sulfides are converted back to the metal oxides before the spent catalyst is discharged, or discharged from the reactor while still containing metal sulfides. In both cases either:

- a. The spent catalyst owner intends to consign the material into a recycling or disposal operation, it will automatically be defined as waste under Directive 2008/98/EC (Art.3 (1)) and thus be exempt from REACH, but must conform to all aspects of waste legislation.

or

- b. If the spent catalyst is being sent off the originating site for regeneration and the ownership of the catalyst does not change, then some national authorities may consider the material as a product rather than a waste. The catalyst user should check with their local competent authority to confirm situations where this will apply.

In the case of treatment before discharge, as the metal oxides have already been registered, up the supply chain, by the catalyst manufacturer, under REACH, the catalyst owner/downstream user (DU) does not have any obligation to register them.

If discharged while still containing metal sulfides, the catalyst owner, the refinery or chemical plant, as the "manufacturer" of the spent catalyst, would be the party to register the substances formed in the reactor. The metal sulfides previously considered as non-isolated intermediates (see section on active catalysts), could be considered as transported isolated intermediates (Art.18.4.).

However, the additional components deposited on the catalyst during service still have to be considered under REACH. Until these components are discharged from the reactor they are non-isolated intermediates and are exempt from REACH (Art 2.1 (c)). Once discharged, petroleum coke is specifically

exempted from registration and evaluation (Art. 2.7(b) Annex V.10). The other contaminants such as vanadium, arsenic and iron could be considered as by-products. If so, they are exempted from registration and evaluation obligations under REACH (exempted under: Art 2.7(b) Annex V.5).

Although these deposited substances may be exempted from REACH registration requirements, their hazards still must be considered and included in any hazard communication documents prepared for the spent catalyst such as Safety Data Sheets (SDS) and labels as they may contribute to the hazards and classification of the spent catalyst.

## 5. Regeneration of spent catalysts

When spent catalysts are regenerated, the site carrying out the regeneration is considered to "manufacture" the regenerated catalyst. Thus under REACH, the legal entity doing the regeneration would be required to register the metal oxides and any other substances created during the regeneration operation.

For chemical substances that result from the regeneration process which are the same as those in the original fresh catalyst (for example the metal oxides), the regeneration site may be exempted from registration requirements under Art.2.7(d), if the substances were properly registered and if the required information is available to them.

Substances different from those in the original catalyst such as vanadium and arsenic deposited on the spent catalyst during its service at the refinery or chemical plant must be registered by the regeneration site under REACH, unless they can be considered as by-products and thereby exempted (Art 2.7 b Annex V point 5).

## 6. Metal recycling

When spent catalyst is the object of recycling, the site doing the reclaim operation is considered to "manufacture" the metals that are reclaimed. However, similar to the regeneration activity above, if the substances recovered are the same as the ones that have already been registered the recovery site does not have to register them under REACH. If the substances recovered are different chemical substances, then the reclaim site must register them under REACH.

When transporting spent catalyst for metals recycling, it will be classified as a waste, and the appropriate EU Waste, OECD and Basel Convention regulations must be followed.

Substances that remain after the reclaim/recycling operation and which are being disposed of as waste would fall outside of REACH and instead fall under applicable waste regulations.

### **IMPORTANT NOTE:**

In any case where an exemption for registration is claimed for a substance because it is "already registered up the supply chain", the claimant has to be able to justify such a claim and needs to produce the supporting documentation such as volumes and substance identity. This will be most likely a case-by-case process involving the whole supply chain up to the registrant.

## 7. On-site activation of hydroprocessing catalysts

For hydroprocessing catalysts that are activated on-site new substances may be formed which require registration for REACH by the legal entity where this occurs. This is illustrated in Figure 1.

It must be cautioned that additional or different substances may be formed on individual sites, that there are other types of catalyst and processes that may also form substances with REACH registration implications and that ultimately, it is the responsibility of each legal entity to decide what substances, if any, they will register for REACH. More specific guidance on a catalyst by catalyst basis may be available from the individual catalyst manufacturers. The information presented here is NOT the only process that needs to be reviewed and hydroprocessing catalysts are only chosen as an example.

The guidance presented in earlier parts of this document still apply and should be used to help decide what should be done for REACH compliance.

The following list represents some, but not all as other activated metal species may also exist, of the most common substances that may be formed when generic hydroprocessing catalysts are activated on-site. In addition, common reference books indicate that the activation reactions of multi-metallic catalysts such as nickel molybdenum (NiMo) and nickel tungsten (NiW) produce trinickel disulfide, whereas nickel sulfide is produced during the activation of mono-metallic catalysts.

Substance	Formula	CAS	EINECS
Nickel sulfide*	NiS	16812-54-7	240-841-2
Trinickel disulfide	Ni <sub>3</sub> S <sub>2</sub>	12035-72-2	234-829-6
Cobalt sulfide*	CoS	1317-42-6	215-273-3
Molybdenum disulfide*	MoS <sub>2</sub>	1317-33-5	215-263-9
Tungsten disulfide	WS <sub>2</sub>	12138-09-9	235-243-3

\*Other CAS/EINECS numbers exist for these substances. These references should normally be included in the same SIEF as those above as shown in the examples below.

Substance	CAS	EINECS
Nickel sulfide (not further specified)	11113-75-0	234-349-7
Cobalt sulfide (not further specified)	12653-56-4	235-751-5
Molybdenum sulfide (not further specified)	12612-50-9	235-721-1

## Definitions

**Manufacturer** - Any natural or legal person established within the Community who manufactures a substance within the Community.

**Downstream user** - Any natural or legal person established within the Community, other than the manufacturer or the importer, who uses a substance, either on its own or in a preparation, in the course of his industrial or professional activities. A distributor or a consumer is not a downstream user. A re-importer exempted pursuant to Article 2(7)(c) shall be regarded as a downstream user.

**Substance** - A chemical element and its compounds in the natural state or obtained by any manufacturing process, including any additive necessary to preserve its stability and any impurity deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition.

**Intermediate** - A substance that is manufactured for and consumed in or used for chemical processing in order to be transformed into another substance.

**Preparation** - A mixture or solution composed of two or more substances.

**Waste** - Any substance or object which the holder discards or intends.

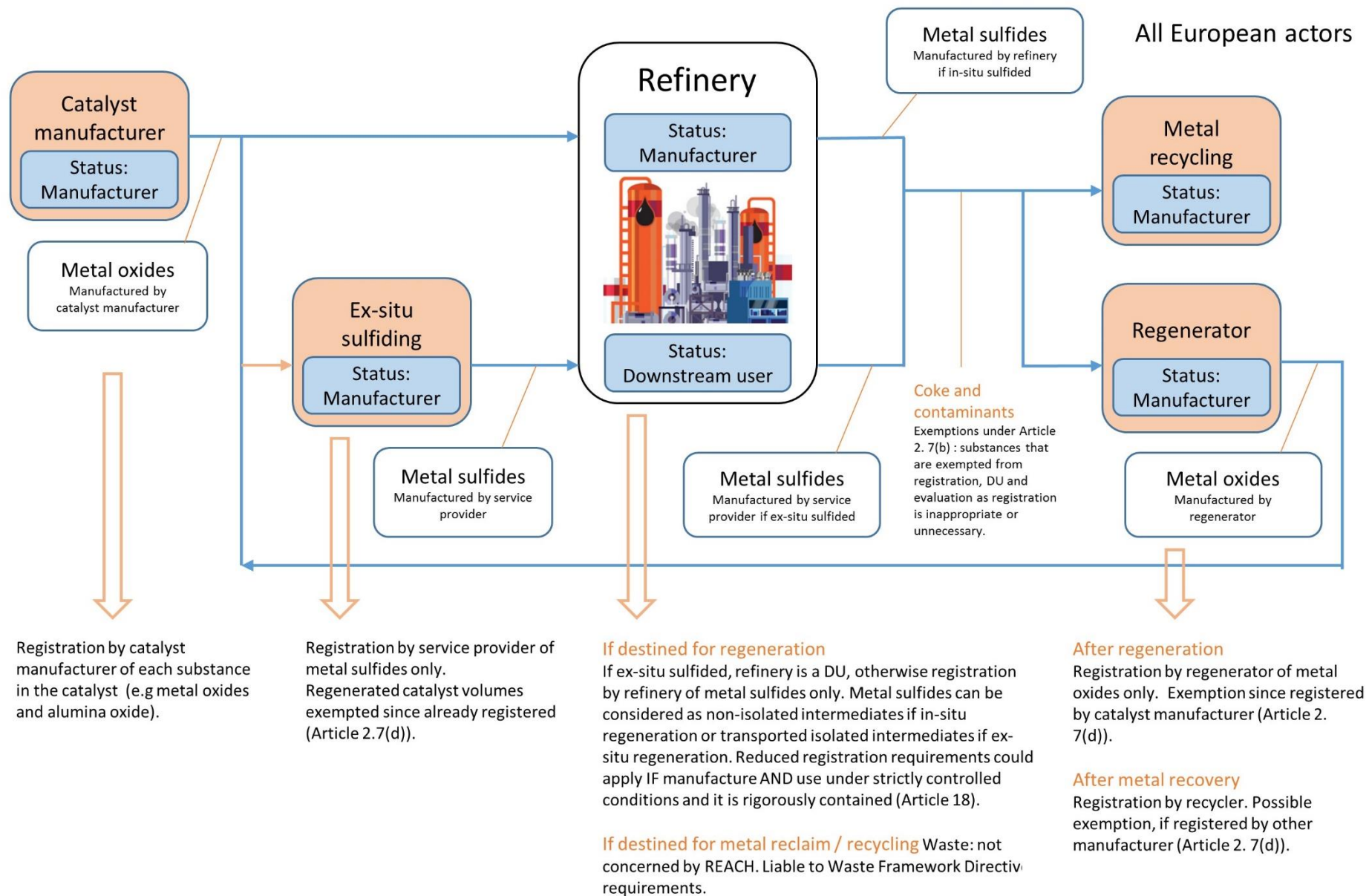


Figure 1: Hydroprocessing catalyst life cycle REACH responsibilities.

## **Disclaimer**

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### **About Catalysts Europe**

Catalysts Europe, the European Catalyst Manufacturers Association, is a sector group of the European Chemical Industry Council (Cefic) and represents the leading catalyst producers in Europe. Catalyst Europe is a non-profit organisation established in 1983 and dedicated to promoting the safe use and benefits of catalysts to society.

*Version - ECMA1028d – October 2018*

*Previous versions:*

*May 2012 – Waste framework directive and EINICS/CAS for MoS<sub>2</sub>*

*November 2009 – Amended hydroprocessing catalysts and intermediates without SCC*

*November 2008 – Hydroprocessing catalysts added*

*September 2008 – Original version*