

**GUIDELINES ON BEST AVAILABLE  
TECHNIQUES AND PROVISIONAL GUIDANCE  
ON BEST ENVIRONMENTAL PRACTICES**

**relevant to Article 5 and Annex C  
of the Stockholm Convention on  
Persistent Organic Pollutants**

---

Waste oil refineries



This publication may be reproduced in whole or in part in any form for educational or non-profit purposes without special permission, provided acknowledgement of the source is made. The Secretariat of the Stockholm Convention and UNEP would appreciate receiving a copy of any publication that uses this publication as a source. No use of this publication may be made for resale or for any other commercial purpose whatsoever without prior permission in writing from the United Nations Environment Programme.

Published by the Secretariat of the Stockholm Convention on Persistent Organic Pollutants in October 2008. For more information please contact:

Secretariat of the Stockholm Convention on Persistent Organic Pollutants  
United Nations Environment Programme  
International Environment House  
11-13 chemin des Anémones  
CH-1219, Châtelaine, Geneva, Switzerland  
ssc@pops.int - [www.pops.int](http://www.pops.int)

Designed and printed by: SRO-Kundig - Geneva

**GUIDELINES ON BEST AVAILABLE  
TECHNIQUES AND PROVISIONAL GUIDANCE  
ON BEST ENVIRONMENTAL PRACTICES**

**relevant to Article 5 and Annex C  
of the Stockholm Convention on  
Persistent Organic Pollutants**

MAY 2007, GENEVA, SWITZERLAND

# C O N T E N T S

## **SECTION I: INTRODUCTION**

- I.A** PURPOSE
- I.B** STRUCTURE OF DOCUMENT AND USING GUIDELINES AND GUIDANCE
- I.C** CHEMICALS LISTED IN ANNEX C: DEFINITIONS, RISKS, TOXICITY
- I.D** ARTICLE 5 AND ANNEX C OF THE STOCKHOLM CONVENTION
- I.E** RELATIONSHIP TO THE BASEL CONVENTION
- I.F** RELATIONSHIP TO OTHER ENVIRONMENTAL CONCERNS

## **SECTION II: CONSIDERATION OF ALTERNATIVES IN THE APPLICATION OF BEST AVAILABLE TECHNIQUES**

- II.A** CONSIDERATION OF ALTERNATIVES IN THE STOCKHOLM CONVENTION
- II.B** THE STOCKHOLM CONVENTION AND NEW SOURCES
- II.C** AN APPROACH TO CONSIDERATION OF ALTERNATIVES
- II.D** OTHER CONSIDERATIONS OF THE STOCKHOLM CONVENTION

## **SECTION III: BEST AVAILABLE TECHNIQUES AND BEST ENVIRONMENTAL PRACTICES: GUIDANCE, PRINCIPLES AND CROSS-CUTTING CONSIDERATIONS**

- III.A** GUIDANCE
- III.B** GENERAL PRINCIPLES AND APPROACHES
- III.C** CROSS-CUTTING CONSIDERATIONS:
  - (i) CHEMICALS LISTED IN ANNEX C: FORMATION MECHANISMS
  - (ii) WASTE MANAGEMENT CONSIDERATIONS
  - (iii) CO-BENEFITS OF BEST AVAILABLE TECHNIQUES FOR CHEMICALS LISTED IN ANNEX C
  - (iv) MANAGEMENT OF FLUE GAS AND OTHER RESIDUES
  - (v) TRAINING OF DECISION MAKERS AND TECHNICAL PERSONNEL
  - (vi) TESTING, MONITORING AND REPORTING

## **SECTION IV: COMPILATION OF SUMMARIES FROM THE SOURCE CATEGORIES INCLUDED IN SECTIONS V AND VI**

SUMMARIES OF SECTION V: SOURCE CATEGORIES INCLUDED IN PART II OF ANNEX C

SUMMARIES OF SECTION VI: SOURCE CATEGORIES INCLUDED IN PART III OF ANNEX C

## **SECTION V: GUIDANCE/GUIDELINES BY SOURCE CATEGORIES: SOURCE CATEGORIES IN PART II OF ANNEX C**

- V.A** WASTE INCINERATORS
  - (i) MUNICIPAL SOLID WASTE, HAZARDOUS WASTE AND SEWAGE SLUDGE
  - (ii) MEDICAL WASTE
- V.B** CEMENT KILNS FIRING HAZARDOUS WASTE
- V.C** PRODUCTION OF PULP USING ELEMENTAL CHLORINE OR CHEMICALS GENERATING ELEMENTAL CHLORINE
- V.D** THERMAL PROCESSES IN THE METALLURGICAL INDUSTRY
  - (i) SECONDARY COPPER PRODUCTION
  - (ii) SINTER PLANTS IN THE IRON AND STEEL INDUSTRY
  - (iii) SECONDARY ALUMINIUM PRODUCTION
  - (iv) SECONDARY ZINC PRODUCTION

## **SECTION VI: GUIDANCE/GUIDELINES BY SOURCE CATEGORIES: SOURCE CATEGORIES IN PART III OF ANNEX C**

- VI.A** OPEN BURNING OF WASTE, INCLUDING BURNING OF LANDFILL SITES
- VI.B** THERMAL PROCESSES IN THE METALLURGICAL INDUSTRY NOT MENTIONED IN ANNEX C PART II
  - (i) SECONDARY LEAD PRODUCTION
  - (ii) PRIMARY ALUMINIUM PRODUCTION
  - (iii) MAGNESIUM PRODUCTION
  - (iv) SECONDARY STEEL PRODUCTION
  - (v) PRIMARY BASE METALS SMELTING

<b>VI.C</b>	RESIDENTIAL COMBUSTION SOURCES
<b>VI.D</b>	FOSSIL FUEL-FIRED UTILITY AND INDUSTRIAL BOILERS
<b>VI.E</b>	FIRING INSTALLATIONS FOR WOOD AND OTHER BIOMASS FUELS
<b>VI.F</b>	SPECIFIC CHEMICAL PRODUCTION PROCESSES RELEASING CHEMICALS LISTED IN ANNEX C
<b>VI.G</b>	CREMATORIA
<b>VI.H</b>	MOTOR VEHICLES, PARTICULARLY THOSE BURNING LEADED GASOLINE
<b>VI.I</b>	DESTRUCTION OF ANIMAL CARCASSES
<b>VI.J</b>	TEXTILE AND LEATHER DYEING (WITH CHLORANIL) AND FINISHING (WITH ALKALINE EXTRACTION)
<b>VI.K</b>	SHREDDER PLANTS FOR THE TREATMENT OF END-OF-LIFE VEHICLES
<b>VI.L</b>	SMOLDERING OF COPPER CABLES
<b>VI.M</b>	WASTE OIL REFINERIES

# Section VI.M

Guidance/guidelines by source category:  
Source categories in Part III of Annex C

**Part III Source category (m):  
Waste oil refineries**

# C O N T E N T S

<b>VI.M Waste oil refineries</b> .....	9
1. Introduction .....	10
2. Waste oils.....	10
3. Occurrence of polychlorinated dibenzo- <i>p</i> -dioxins and polychlorinated dibenzofurans (PCDD/PCDF) in used oils.....	10
4. Waste oil refineries.....	10
4.1 Vacuum distillation + clay treatment .....	11
4.2 Vacuum distillation + chemical treatment .....	11
4.3 Hydrogen pretreatment + vacuum distillation .....	11
4.4 Thin film evaporation + extraction .....	11
4.5 Direct contact hydrogenation (UOP-DCH process).....	11
5. Measures for reduction of polychlorinated dibenzo- <i>p</i> -dioxins (PCDD), polychlorinated dibenzofurans (PCDF) and polychlorinated biphenyls (PCB).....	12
6. Conclusions.....	12
References .....	12



### ■ Summary

Waste oil refineries are listed in Annex C of the Stockholm Convention as a source that has the potential to form and release chemicals listed in Annex C.

For the purpose of this guidance section, waste oils (or used oils) are defined as any petroleum-based, synthetic, or plant- or animal-based oil that has been used. Waste oils may originate from two large sources: industrial waste oils, and vegetable and animal waste oils. Among the industrial waste oils, three main oil streams can be identified: industrial oil (e.g. hydraulic oil, engine lubricant, cutting oil); garage or workshop oil; and transformer oil.

Waste oils have been found to be contaminated with polychlorinated dibenzo-*p*-dioxins, polychlorinated dibenzofurans and polychlorinated biphenyls. At present there is no available evidence that polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans or polychlorinated biphenyls, are newly formed in waste oil refineries. The data available indicate that the polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans or polychlorinated biphenyls released from waste oil refineries or waste oil handling and management plants are from industrial, intentional production of polychlorinated biphenyls or chlorobenzenes that are present in the waste oils either by contamination in the synthesis process (of these chemicals) or have become contaminated during the use phase or earlier recycling processes. In this sense, waste oil refineries represent a distribution source of chemicals listed in Annex C rather than a formation source.

According to available information, waste oil management options include reuse or regeneration; thermal cracking; and incineration or use as fuel. It should be noted that dumping and open burning are also practised in many countries.

For information on waste oil disposal in incinerators or on use as fuel, the relevant sections of this guidance document should be consulted (sections V.A Waste incinerators, V.B Cement kilns firing hazardous waste, VI.A Open burning of waste, VI.C Residential combustion sources, and VI.D Fossil fuel-fired utility and industrial boilers).

## 1. Introduction

Waste oil refineries are listed in Annex C of the Stockholm Convention as a potential source of chemicals listed in Annex C. The information reported about waste oil refineries as sources of polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) is very limited and further research is needed.

## 2. Waste oils

Waste oils include any petroleum-based or synthetic oil that has been used. Water, chemicals, metal particles and dirt become mixed in with the oil during use, degrading its properties until it must be replaced by new oil.

New oils are a mixture of a base oil (mineral or synthetic) and additives (15–25%). The type of base oil and additives determine the possibility of regeneration and the possible formation of PCDD/PCDF in waste oil refineries.

## 3. Occurrence of polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDD/PCDF) in used oils

Hagenmaier and Brunner (cited by Fiedler) analyzed new and used (after 10,000 km in cars fuelled with leaded gasoline) motor oils. At a limit of quantification of 0.05 mg/kg per congener, no polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans could be detected in fresh and used motor oils. However, highly chlorinated polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans were detected in recycled oils, probably from used oils contaminated with pentachlorophenol and its sodium salt, which in Europe were used in the mineral oil industry. It must

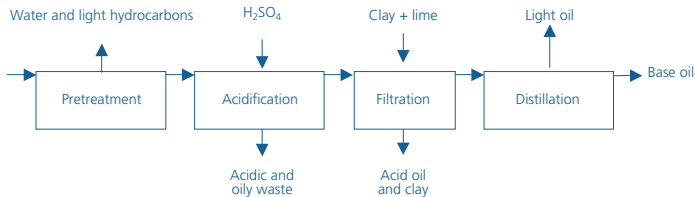
be noted that some of the additives used in modern lubricant oils contain chlorinated compounds and it is necessary to continue monitoring waste oils fed to refineries.

## 4. Waste oil refineries

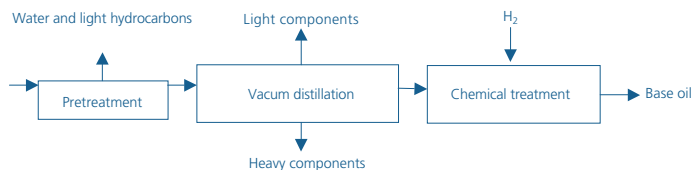
Waste oil refineries are designed to produce a base blending oil, some by-products and some wastes. The lighter parts of the by-products may be used as fuel; the heaviest, containing additives and carbonaceous species, may be used as a blending component in road surfaces.

Five technologies are representative of waste oil refineries:

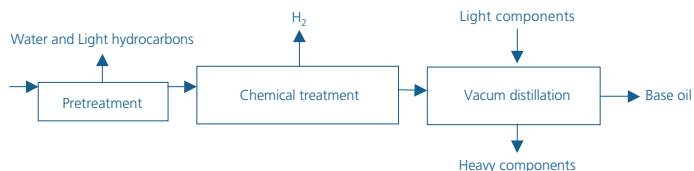
#### 4.1 Vacuum distillation + clay treatment



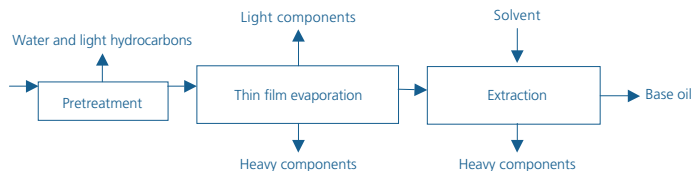
#### 4.2 Vacuum distillation + chemical treatment



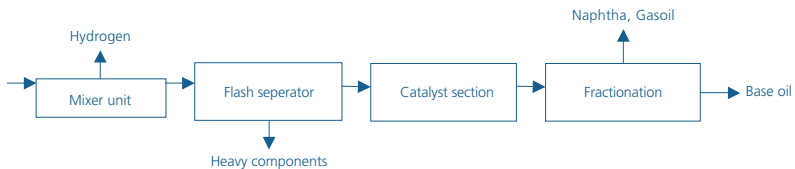
#### 4.3 Hydrogen pretreatment + vacuum distillation



#### 4.4 Thin film evaporation + extraction



#### 4.5 Direct contact hydrogenation (UOP-DCH process)



## 5. Measures for reduction of polychlorinated dibenzo-p-dioxins (PCDD), polychlorinated dibenzofurans (PCDF) and polychlorinated biphenyls (PCB)

As previously indicated, PCDD/PCDF and PCB in oil base or residue from waste oil refineries emanate from contaminated waste oils. Therefore, one basic measure to reduce PCDD/PCDF and PCB emissions from such refineries is to only treat waste oils with low PCDD/PCDF and PCB concentrations.

The European Re-refining Industry Association (Groupement Européen de l'Industrie de la Régénération; GEIR) recommend that the following waste oils be preferred for regeneration:

- Engine oils without chlorine;
- Hydraulic oils without chlorine;
- Non-chlorinated mineral diathermic oils.

## 6. Conclusions

- Waste oils have been found to be contaminated with PCDD, PCDF and polychlorinated biphenyls (PCB);
- At present there is no available evidence that PCDD, PCDF and PCB are newly formed in waste oil refineries;
- Waste oil refineries are a distribution source of chemicals listed in Annex C rather than a formation source;
- The waste oil treated in waste oil refineries must have a low content of PCDD, PCDF, PCB and chlorinated additives.

## References

Hagenmaier H. and H. Brunner. 1986. Bestimmung polychlorierter Dibenzodioxine und polychlorierter Dibenzofurane in Motorölen, Altölen und Zweitraffinaten. Fresenius Z. Anal.Chem.324, 23-26

Ruiz E. 1991. "Aceites Lubricantes para Motores a Gasolina." In: *Material del Curso de Educación Continuada: Fundamentos Básicos de Lubricantes*. Bogotá, Colombia.



<http://www.pops.int>

UNEP/SSC/BATBEP/2008/18

Section I-IV  
Section VA  
Section VB  
Section VC  
Section VD  
Section VA  
Section VB  
Section VC  
Section VD  
Section VEA  
Section VEB  
Section VEC  
Section VED  
Section VEE  
Section VEF  
Section VEG  
Section VIH  
Section VII  
Section VIK  
Section VIL  
Section VIL