



VAASAN AMMATTIKORKEAKOULU
VASA YRKESHÖGSKOLA
UNIVERSITY OF APPLIED SCIENCES

Hanna-Maija Honkanen

WASTE AND CHEMICAL
MANAGEMENT ON WÄRTSILÄ POWER
PLANT CONSTRUCTION SITE

Technology and Communication
2011

TIIVISTELMÄ

Tekijä	Hanna-Maija Honkanen
Opinnäytetyön nimi	Waste and Chemical Management on Wärtsilä Power Plant Construction Site
Vuosi	2011
Kieli	englanti
Sivumäärä	59 + 2 liitettä
Ohjaaja	Riitta Niemelä

Tämä opinnäytetyö on tehty Wärtsilän tarpeisiin. Wärtsilä on kansainvälinen yritys, joka toimittaa voimaratkaisuja laivateollisuuden käyttöön ja voimalaitoksia hoitaen alusta loppuun suunnittelun, rakennuttamisen, projektihallinnan sekä huoltopalvelut. Työn tarkoituksena on parantaa jätteiden ja kemikaalien hallintaa Wärtsilän voimalaitosrakennustyömailla.

Rakennusjätteet sekä kemikaalien hallinta ovat tärkeitä rakennustyömaan ympäristönäkökohtien kannalta. Rakennusjätteissä on niiden määrään suhteutettuna vähän ympäristölle suoraan haitallisia aineita, mutta rakennusjätteet aiheuttavat kuitenkin huomattavan ympäristökuormituksen niiden suuren määrän takia. Rakennustyömailla on käytössä paljon kemikaaleja. Osa on melko harmittomia, mutta osa voi aiheuttaa vakavaa haittaa niin ihmisille kuin ympäristölle.

Projektiin toteutukseen sisältyi käytännön osuus Wärtsilän voimalaitoksen rakennustyömaalla Tsadissa, missä tarkoituksena oli kerätä tietoja ja ideoita työmaan jätteiden ja kemikaalien hallinnasta. Toinen osa työstä oli Wärtsilän toimistolla rakennustyömaan jätteiden hallintasuunnitelman ja Power Plants:in kemikaalilistan kehittämistä sekä kirjallisten tietolähteiden läpikäymistä.

Opinnäytetyön yhteydessä kehitettiin jätteiden hallintasuunnitelma Wärtsilän työmaalle, joka tulisi täyttää ja muokata projektikohtaisesti ja laittaa rakennustyömaalla työntekijöiden nähtäväksi. Tarkoituksena on, että jätteiden hallinnan suunnitteluun panostettaisiin ja jätehuolto työmaalla voisi olla toimiva projektin alusta alkaen. Kemikaalihallinnan kehittämisen yhteydessä tehtiin kemikaalilistapohja, jonne kerätään tiedot Power Plants:in käyttämistä rakennusvaiheen kemikaaleista. Tavoitteena on parantaa kemikaalitietojen saatavuutta työmailla ja koko Power Plants:issa.

Avainsanat	rakennusjätteet, kemikaalit	rakennustyömaat,	ongelmajätteet,
------------	--------------------------------	------------------	-----------------

ABSTRACT

Author	Hanna-Maija Honkanen
Title	Waste and Chemical Management on Wärtsilä Power Plant Construction Site
Year	2011
Language	English
Pages	59 + 2 Appendices
Name of Supervisor	Riitta Niemelä

This thesis is made for Wärtsilä which is an international company operating in energy market. Wärtsilä supplies power solutions for marine industry and power plants managing whole lifecycle from product development, manufacturing and project management to servicing. The purpose of this thesis is to enhance waste and chemical management at Wärtsilä power plant construction sites.

Construction waste and chemical management are important environmental aspects at construction sites. There are actually little materials that are directly harmful to environment in construction waste. Despite that, construction waste incurs significant environmental impact because of its considerable amount. On construction sites, also lot of chemicals are used. Some of them are harmless but some can cause serious harm to both human and the environment.

This project included a practical part that was implemented in Wärtsilä power plant construction site in Chad, where information and ideas of waste and chemical management at the site were collected. Other part of the project included developing of the construction site waste management plan and Power Plants' chemical list as well as examination of literally sources of information.

During the thesis work, the waste management plan was developed for Wärtsilä construction sites which should be filled and modified to each project and be situated in view of employees at site. The purpose is to improve waste management planning and ensure that the waste management is functional from beginning of a project. In addition a chemicals list template was developed, where information of chemicals used on construction sites of Power Plants is collected. The aim is to improve availability of information of chemicals at construction site and in Power Plants.

Keywords	Construction waste, construction site, hazardous waste, chemicals
----------	---

CONTENTS

TIIVISTELMÄ

ABSTRACT

1	INTRODUCTION	8
2	BACKGROUND AND PURPOSE.....	10
3	INTRODUCTION OF WÄRTSILÄ	11
	3.1 Wärtsilä Power Plants	12
	3.2 Wärtsilä Ship Power	13
	3.3 Wärtsilä Service	13
4	APPROACH AND IMPLEMENTATION OF THE PROJECT.....	14
	4.1 Introduction of Farcha II Wärtsilä Power Plant site	14
	4.2 Methods.....	15
5	CONSTRUCTION WASTE IN GENERAL.....	16
	5.1 Definition and legislation.....	16
	5.2 Formation and consistency	17
	5.3 Industrial building.....	19
	5.4 Packaging waste.....	19
6	CHEMICAL MANAGEMENT ON A CONSTRUCTION SITE IN GENERAL	21
	6.1 Legislation.....	21
	6.1.1 Safety data sheets	22
	6.2 Chemicals and safety at construction site	24
	6.2.1 Chemical types	25
	6.2.2 Risk assessment.....	27
	6.2.3 Instructions for chemical handling and storing.....	29
	6.3 Hazardous waste	29
	6.3.1 Waste oils	29
7	PRESENT STATE OF WASTE AND CHEMICAL MANAGEMENT ON POWER PLANT CONSTRUCTION SITE	31
	7.1 Power Plants construction site process	31
	7.1.1 Responsibilities	32
	7.2 Instructions.....	33
	7.3 Waste management	35
	7.3.1 Sorting of waste	35

7.3.2	Waste types	37
7.3.2.1	Mineral waste.....	37
7.3.2.2	Wood waste.....	38
7.3.2.3	Metal	39
7.3.2.4	Mixed construction waste	39
7.3.2.5	Plastic waste.....	39
7.3.2.6	Cardboard.....	40
7.3.2.7	Septic waste	40
7.3.2.8	Paper	40
7.3.2.9	Hazardous waste	40
7.3.3	Amounts of waste.....	41
7.3.4	Packaging material	42
7.4	Chemical management.....	43
7.4.1	Chemical types	43
7.4.2	Pickling and flushing	44
7.4.3	Chemical handling and storing at the site	45
7.4.4	Oil and chemical spills	45
8	IMPROVEMENTS AND SUGGESTIONS TO ENHANCE WASTE AND CHEMICAL MANAGEMENT	47
8.1	Waste management plan	47
8.2	Chemicals list of Power Plants	48
8.3	Suggestions to enhance waste management	50
8.3.1	Cleaning at the site	50
8.3.2	Waste management and HSE in contracts	51
8.3.3	Information in packing lists	51
8.3.4	Waste collecting area and safety signs.....	52
9	CONCLUSION AND DISCUSSION	53
	REFERENCES.....	55
	APPENDICES	
	1. Waste management plan	
	2. Chemicals list of Wärtsilä Power Plants	

GLOSSARY

CFC	Chlorofluorocarbon
CLP	The European Union enacted Regulation (EC) No 1272/2008 on classification, labeling and packaging of substance and mixtures
EC	European Commission
EEQ	Engineering equipment delivery
EIA	Environmental impact assessment
EPC	Engineering, Procurement and Construction
EU-27	the European Union consisting of 27 member states
FAO	Food and Agriculture Organization
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
IBC Code	International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk
ICSCs	International Chemical Safety Cards
IDM	Wärtsilä Integrated Management System
ILO	International Labour Organization
IPCS	International Programme on Chemical Safety
ISPM 15	International Standards for Phytosanitary Measures No. 15
ISO	the International Organization for Standardization
HFO	Heavy fuel oil
HSE	Health, safety and environment
LFO	Light fuel oil
LTI	Lost Time Injury
MARPOL	Marine Pollution, the International Convention for the Prevention of Pollution from Ships
MSDS	Material safety data sheet
OHSAS	Occupational health and safety management systems
PBT	Persistent, bioaccumulative and toxic
PCB	Polychlorinated biphenyl
PPE	Personal protective equipment

PVC	Polyvinyl chloride
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals (EC 1907/2006)
SDS	Safety data sheet
SQAD	the Site Quality Assurance Set
UN number	United Nations number, a four-digit number for classification of dangerous goods
vPvB	Very persistent and very bioaccumulative
VTT	Technical Research Centre of Finland
WHO	World Health Organization

1 INTRODUCTION

Construction waste is considerable share of total waste generation. In many countries it accounts almost one quarter of total waste amount. Even though the major part of the construction waste is harmless the total amount of construction waste is so significant that also its environmental impact is substantial.

Safe chemical management at construction site is another environmental issue related to construction activity. It is an important aspect from the occupational safety point of view. Chemicals that are used on construction sites can cause serious harm if there is no knowledge of safe handling of them.

This work is related to a project in Wärtsilä, which is company operating in energy market. Wärtsilä manages whole lifecycle power solutions of power plants and marine energy packages. Waste and chemical management is one part of health, safety and environment section to be improved in Wärtsilä Power Plants.

The requirements concerning environmental issues have increased and this puts pressure also on industrial operations and actors. Developing a waste management plan for Wärtsilä Power Plants was topical theme for thesis because there was demand for it. There are no earlier studies focusing on this theme made for Wärtsilä.

The purpose was to approach this project from the practical point of view. The project started with practical part implemented in Wärtsilä Power Plant construction site in Chad where was collected the needed information. The second part of the project consisted of planning, developing and writing part at the Wärtsilä office in Vaasa.

The planning of chemical and waste management on construction sites is challenging because the circumstances are continuously changing and there is operating employees from several companies on site. Nationalities and cultural backgrounds are also varying on Wärtsilä power plant construction sites. This puts

challenge to the advancement of occupational health, safety and environment aspects on the sites.

2 BACKGROUND AND PURPOSE

Health, safety and environment (HSE) management is a part of Wärtsilä Power Plants' Quality Management Organization. Wärtsilä has an ISO 14001 – certificate. The main principle of the ISO 14 001 -environment management system is to improve environmental issues and its goal is to be more and more efficient and take environment on account. Wärtsilä has also OHSAS 18 001-occupational health and safety management systems. Both these standards are based on steps which are: planning, implementation and operation, checking and monitoring including reporting of the results and taking actions to continually improve the performance. Wärtsilä Finland is committed to comply with these standards and operate everywhere according them.

The starting point of this project was in Environmental objectives, targets and programmes since 2009 – team meeting of Wärtsilä Finland. It was set as one of the special projects which goal was to add focus on environmental issues at construction sites. This waste and chemical management -project is a part of actions to improve environmental aspects in Wärtsilä Power Plants.

The assignment given to me concerned waste and chemical management on construction site of Power Plants. One important part of my work was to think how to enhance waste management on construction site and what kind of waste management plan there should be in construction projects. Other task was to investigate chemicals and handling practices on power plant construction sites.

Wärtsilä Power Plants construction projects are worldwide. Projects have to operate complying with local regulations and legislations. In this thesis is introduced European Commission regulation related to waste and chemical management. EU regulation is enacted in several European countries and it involves like good frame for taking account environmental aspects.

3 INTRODUCTION OF WÄRTSILÄ

Wärtsilä operates in the marine and energy markets. Wärtsilä manages whole lifecycle power solutions from product development, design, sales and project management to manufacture and servicing of power plants and marine energy packages. Wärtsilä's mission is to provide lifecycle power solutions to enhance the business of their customers, whilst creating better technologies that benefit both the customer and the environment. /44/

Wärtsilä is an international large-scale enterprise which roots are in Finland. Wärtsilä is established in 1834 operating first in sawmill industry. From those days Wärtsilä's business scope has changed through iron manufacturing to marine and energy industry. Wärtsilä operates in 70 different countries on 160 different locations around the world. The share of different regions is presented in Order Intake Chart (Figure 1.). In 2010 Wärtsilä's net sales was 4.6 billion euro and the number of employees was 17 500. /44/, /35/

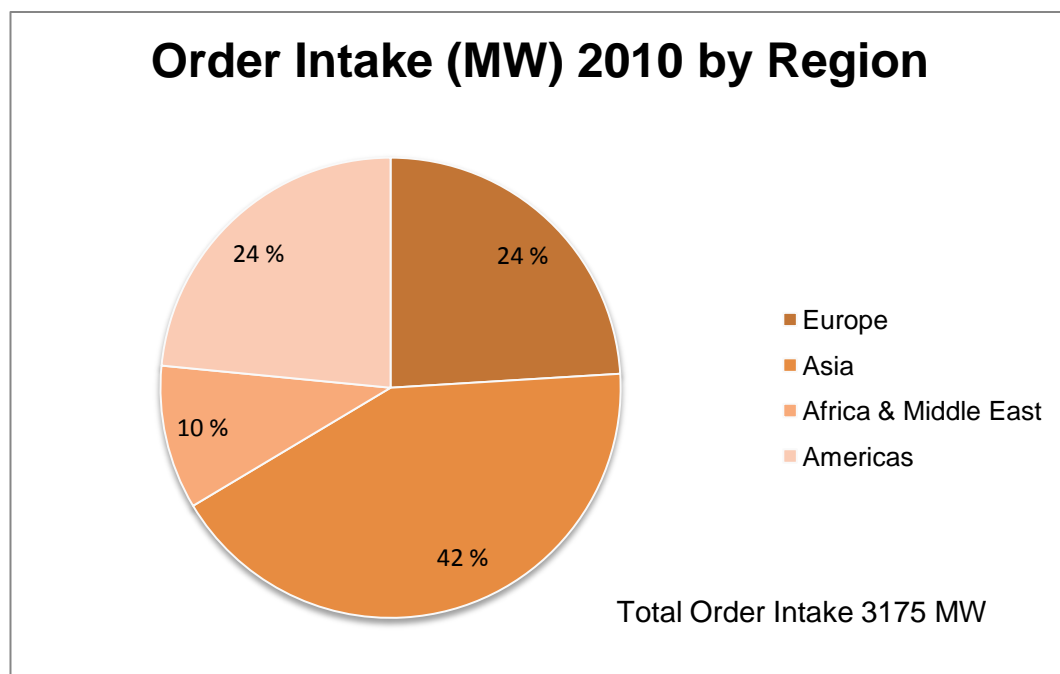


Figure 1. Order intake of Wärtsilä in 2010 by region. /40/

In the Wärtsilä Policy for Quality, Health & Safety and the Environment it is declared that the objective is to meet or exceed customers' and other stakeholders' expectations being reliable and safe, efficient and environmentally sound and compliant with applicable legal requirements and regulations. In addition Wärtsilä is committed to continually improve the performance and reduce adverse environmental impact, through objectives set by management. Wärtsilä is divided into three branches: Ship Power, Power Plants and Services. /32/

3.1 Wärtsilä Power Plants

Power Plants supplies power plants for base load, peaking and industrial self-generation purposes and for the oil and gas industry. Power plants are flexible designed and efficient and they have low emission levels. Wärtsilä is a major player in the decentralized power generation market. /44/

Power Plants is a major supplier of flexible base load power plants operating on various fuels. Power Plants accounted for 34 % of Wärtsilä's net sales in 2010 even though only 5 % of the total personnel of Wärtsilä worked for Power Plants. /40/

Wärtsilä Power Plants has wide range of fuel options: light fuel oil, heavy fuel oil, crude oil, liquid bio fuels as vegetable oils, animal fats and biodiesels, natural gas, liquefied natural gas and biogases. The shares of natural gas orders are increasing inevitably /18/.

Power Plants can deliver power plants or power solutions in various scales from EPC (engineering, procurement, construction) where power plant is built as all-inclusive turnkey package by Wärtsilä to EEQ (engineering equipment delivery) where only part of the whole power solution is delivered by Wärtsilä. Wärtsilä's power plants are built from modular pre-fabricated elements that minimize work at site /40/. In Figure 2. is ready power plant supplied for Termocabo by Wärtsilä with total output of 48 MW /29/.

3.2 Wärtsilä Ship Power

Ship Power provides integrated systems, solutions and products for marine industry including ship machinery, propulsion and manoeuvring solutions. Wärtsilä can provide engines and generating sets, reduction gears, propulsion equipment, control systems and sealing solutions for all kind of vessels and boats.

/44/

3.3 Wärtsilä Service

Services is supporting the customers throughout the lifecycle of the installations by providing services, maintenance and reconditioning solutions for both ship machinery and power plants. Service has the broadest service network in the industry and they are available no matter where the customers are. /44/



Figure 2. Ready Wärtsilä power plant in 2002 with three 18V46 engines. /29/

4 APPROACH AND IMPLEMENTATION OF THE PROJECT

This project included a visit to a Wärtsilä Power Plants construction site situated in Chad. The purpose of that practice part of the project was to get familiar with waste and chemical management at the site at the moment and to see if there is something to improve.

4.1 Introduction of Farcha II Wärtsilä Power Plant site

The practical part of the project was implemented on Wärtsilä Power Plant construction site Centrale de Farcha II situated in Central Africa in Chad. This site was chosen because it was at a convenient construction stage. Most of the shipments had already come to the site and construction work was fully ongoing. The power plant is intended for power generation and it is designed for base load.

Type of the project was EPC where Wärtsilä has the responsibility for constructing the power plant from the beginning to the end. The power plant will have seven W20V32 -type of engines and the total output of the power plant will be 60 MW (Table 1.). Fuel type used in Farcha II is heavy fuel oil (HFO) but light fuel oil (LFO) can be used as an emergency alternative fuel /43/.

Wärtsilä has in this project two main subcontractors SETUBA and SDEM. SETUBA is in charge of civil works and SDEM is responsible for mechanical and building erection work.

Table 1. Basic information of Wärtsilä project Centrale de Farcha II. /41/

Basic information	Type of Project:	EPC
	Total output (MW):	60
	No. of Engines	7
	Engine type:	W20V32
	Fuel Type:	HFO

The construction site is still ongoing and it will be completed and handed over to the customer in 2012. Planned delivery time in this project is approximately two years but it can be extended because there have been some misfortunes caused by weather.

4.2 Methods

The implemented methods in this thesis were practical part executed on construction site and writing and information retrieval for the work at Wärtsilä's office in Vaasa. This project included practical part included collection of information and ideas of waste and chemical management at the site.

Background work for the project was done at Wärtsilä's Vaasa office where also the Wärtsilä's company culture got familiar. After that was visit to Wärtsilä's construction project in Chad. The visit lasted 7 weeks from 31 May to 14 July 2011. The aim was to search ideas to enhance waste and chemical management in Wärtsilä construction sites and collect the needed information for the thesis.

During the time at site was investigation of the chemical management: what kind of chemicals there is used in the site and how they are stored. Also waste management at the construction site was inspected. From shipment documents was calculated packaging material generated in there. Ideas and opinions of Wärtsilä's Section Managers were asked for this thesis.

Other part of the project included developing of the construction site waste management plan and chemicals list of Wärtsilä Power Plants as well as examination of literally sources of information. This work was done mainly in Wärtsilä office.

5 CONSTRUCTION WASTE IN GENERAL

Construction waste contains actually few directly environmental harmful materials. Despite that, construction waste incurs significant environmental impact because of its huge amount. Construction waste includes remarkable amount valuable material fractions that should be reclaimed better. /24/

5.1 Definition and legislation

In the Waste Framework Directive (2008/98/EC) of the European Parliament and of the Council that includes the legislative framework for waste handling waste is defined as followed:

“Waste means any substance or object which the holder discards or intends or is required to discard” /1/

From the scope of this Directive are excluded uncontaminated soil and other naturally occurring material excavated in the course of construction activities where it is certain that the material will be used for the purposes of construction in its natural state on the site from which it was excavated. /1/

Finnish Government Decision on Construction Waste (VnP295/1997) defines construction waste as: any substance or object which the holder discards or intends, or is required, to discard, other than ordinary household waste, generated at the construction site. /15/

In Waste Framework Directive (2008/98/EC) the EU has presented waste hierarchy that should be applied as a priority order in waste prevention and management legislation and policy:

- Prevention
- Preparing for re-use
- Recycling
- Other recovery, e.g. energy recovery
- Disposal

EU's Waste Framework Directive sets a target that by 2020 the preparing for re-use, recycling and other material recovery, including backfilling operations using waste to substitute other materials, of non-hazardous construction and demolition waste excluding naturally occurring material (soil and stones) in the list of waste shall be increased to a minimum of 70 % by weight. /1/

5.2 Formation and consistency

Construction and demolition waste accounts considerable share of total waste amount generated in communities. According Finnish Statistics construction waste was 18,8 % of the total waste amount in 2009. There is seen the affect of the recession because it was one quarter less than year before 2008 when construction waste amount was 25 % of total waste amount in Finland. As reference value in England construction and demolition waste was 26 percent of total non-industrial waste generation in 2007 /5/. /21/

Table 2. Construction waste types and amounts 2007-2009 in Finland, 1000 tons per year /21/.

	2007	2008	2009
Waste type	1000 t		
Waste chemicals	0,1	1	0
Metal	222	249	258
Glass	33	37	39
Paper and cardboard	0	0	0
Plastic and rubber waste	0	1	0
Wood waste	651	729	752
Bio-waste	0	0	0
Mixed inc. household waste	223	236	244
Sludge	0,1	0	0
Mineral waste	24 349	23 726	17 486
Other	0	0	0
TOTAL	25 478	24 979	18 779
including hazardous waste	403	303	289

In Table 2. is presented construction waste types and amounts generated in Finland during 2007-2009. There is no statistics or data currently available of

construction and demolition waste at a European wide level because of lack of statistical reporting /10/.

The largest amount of waste comes from the civil engineering area, and followed by renovation, demolitions and new constructions. According collected information from building registers, Statistics Finland and quantities in VAHTI register building waste was 255 kg per capita (kg/c.) in Finland in 2000. It is divided according its origin between construction, renovation and demolition as following (Figure 3.): construction accounts 41 kg/c., renovation 133 kg/c. and demolition 82 kg/c. The generated quantity of waste was 3-15 kg/built m³ on new building sites, 30-50 kg/built m³ in renovation projects, and 100-500 kg/built m³ in renovation involving extensive demolition. /25/

The most significant share of construction waste is mineral waste. If mineral waste is excluded the most common shares of generated waste types are wood, metal and mixed construction waste (Figure 4.). Hazardous waste accounts about

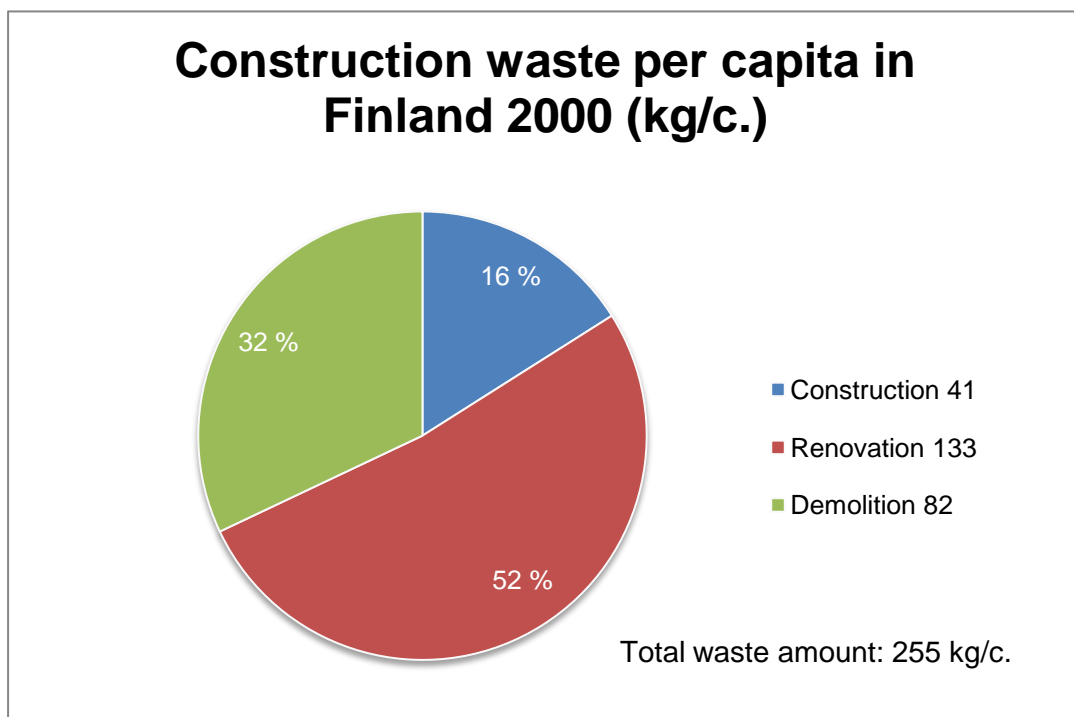


Figure 3. Construction waste kg per capita in Finland divided by construction type 2000. /25/

1-2 % of total construction waste. Hazardous waste is waste that is by its chemical nature or other properties can cause special hazards or risks for human health or the environment /30/.

5.3 Industrial building

Construction of a power plant is counted among industrial building and differs from other building in many ways. Finnish research institute VTT has calculated waste amounts specific for different building types. Warehouse and industrial building causes substantially less waste than for example building a residential building. In residential building people's needs are taken into account and thus building is more complex and varying but the volume of building is tried to be minimized. In industrial building the aim is to maximize volume by minimizing structures so it is simple and cost-effective. /19/

Secondly the construction material of industrial buildings consists often from prefabricated units. Typical materials used in industrial buildings are metal and cement. On the contrary in residential buildings varying materials are used from wood to bricks and also varying building techniques. This causes increased waste amounts.

Advantages of using prefabricated products are that in off-site production it is independent from weather conditions; it will ensure a more continuous activity, a better quality of the finished products and improved control of their environmental characteristics. In addition the use of standardised elements on site will potentially reduce the volume of construction waste and the number of accidents at work. /8/

5.4 Packaging waste

Construction causes lot of packaging waste. The most common types of packaging waste in European countries are paper and cardboard, glass, plastics, wood, and metals (aluminium and steel) in that order (Figure 5.). Packaging legislation in the EU is driven by Directive 2004/12/EC (Packaging Waste Directive) where packaging is defined as any material that is used to contain,

protect, handle, deliver and present goods. Wood is often used for transport packaging. /2/, /11/

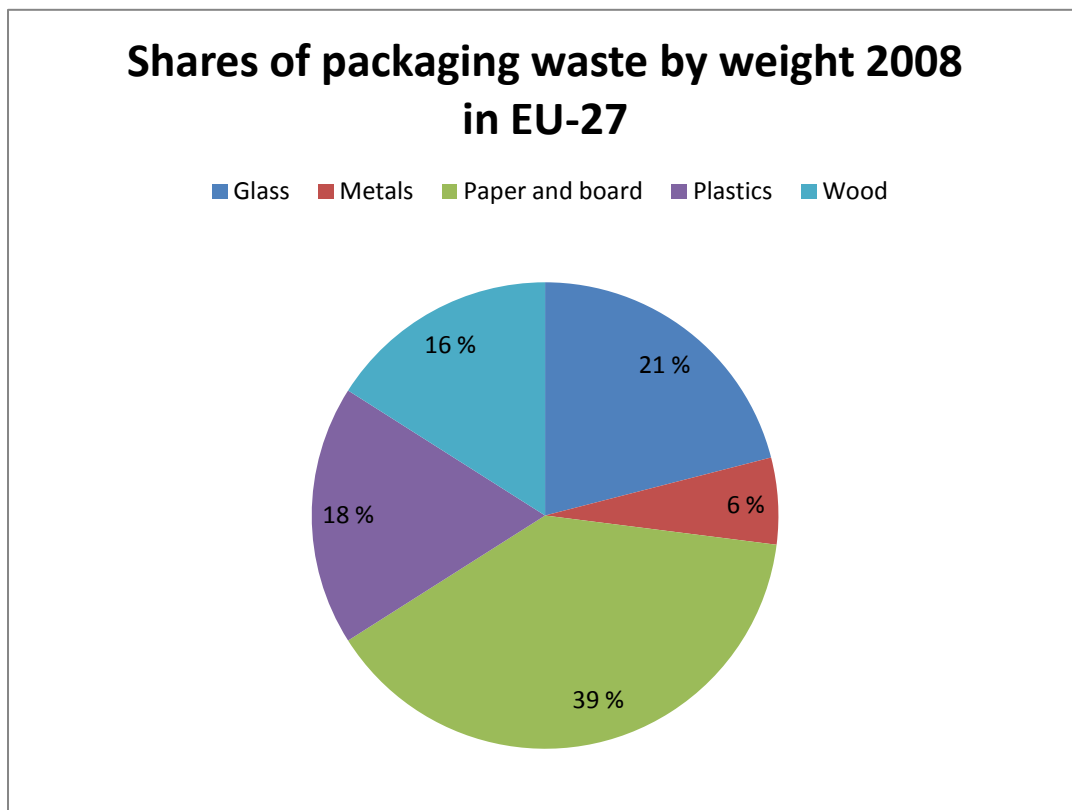


Figure 4. Shares of packaging waste by weight in EU-27 in 2008. /11/

6 CHEMICAL MANAGEMENT ON A CONSTRUCTION SITE IN GENERAL

In construction sites a high number of different chemicals are used. Some of them are harmless but some of them can cause serious harm, for example chemicals that are toxic, flammable, carcinogenic, irritating or dangerous to the environment. The circumstances at construction sites are continuously changing which puts challenge to the management of occupational safety issues on the sites. The company who is the main realizer of the construction project is in charge of the co-ordination of the communications and co-operation throughout the project. /23/

6.1 Legislation

The European Union enacted Regulation (EC) No 1272/2008 on classification, labeling and packaging of substance and mixtures (CLP) which entered into force on 20th January 2009. CLP is implementing the Globally Harmonized System (GHS) of Classification and Labelling of Chemicals within the EU. /13/, /7/

The GHS is developed by the United Nations with aim to harmonize different classification and labeling of physical, environmental, health and safety information of hazardous chemicals around the world. While protecting human health and the environment GHS also facilitates worldwide trade. An exporter does not have to re-classify his product for compliance with different classification and labelling requirements of the country he is exporting to. /7/

Compared to earlier legislation, CLP changes terminology, classification criteria and labeling elements. Substances and mixtures have to be classified, labelled and packaged in accordance with CLP from 1 June 2015. In addition substance and mixture classifications according to CLP have to be provided in the Safety Data Sheets of the chemicals from that day. /6/

REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) is EU's chemicals regulation which aim is to improve the protection of human health and the environment (EC 1907/2006). It gives greater responsibility to

industry to manage the risks from chemicals and to provide safety information. Manufacturers and importers are required to gather information on the properties of their chemical substances and register the information. In Commission Regulation (EU) No 453/2010 was amended the original REACH Regulation with Annex II concerning safety data sheet labelling. /9/, /14/

In EU Directive 98/24/EC is laid down requirements for the protection of workers from risks to their safety and health from the effects of chemical agents that are present at the workplace or are used in their work activity. In the directive is provided indicative and binding occupational exposure limit values within Community. The employer must determine hazardous chemical agents present at the workplace and assess any risk to the safety and health arising from them. /3/, /4/

Risk to the health and safety of workers caused by hazardous chemicals should be eliminated or reduced to a minimum. The risk should be minimized or reduced by among others suitable working procedures including arrangements for the safe handling, storage and transport of hazardous chemicals and waste containing such chemicals. /4/

The employer must inform workers:

- On emergency arrangements.
- On the results of the risk assessment.
- On the hazardous chemicals agents present at the workplace with access to safety data sheets.
- By training on the appropriate precautions and on the personal and collective protection measures that are to be taken. /4/

6.1.1 Safety data sheets

A Safety data sheet is a document that provides information of the properties, risks and safe use of a substance or mixture in industrial or professional use. The bases for safety data sheets are laid down in REACH Regulation 1907/2006 (EC)

in Article 31 of Title IV “information in the supply chain” /9/. Safety data sheet (SDS) can also be known as material safety data sheet (MSDS).

The supplier (manufacturer, importer, downstream user or distributor) is responsible to compile SDSs for chemicals classified as dangerous and chemicals containing dangerous substances or substances that are persistent or very persistent, bio accumulative or very bio accumulative, toxic or included in the “Candidate List” established in Article 59(1). In some cases suppliers have to also provide the SDS for chemical that is not classified as dangerous if so requested by the recipient. /26/

The SDS must be dated and contain the specific headings and be updated as soon as new information of related to chemical’s properties or use becomes available. The SDSs should be provided in the official languages of the Member State where the chemical is placed on the market. In addition the SDSs have to be provided free of charge on paper or electronically. /27/

Regulation (EU) No 453/2010 states the requirements for the information that should be included in the SDS, where applicable and available/10/. In Table 3. are presented main sections that are included in SDS.

Table 3. Main sections in safety data sheets. /12/

Section	Content
1. Identification of the substance/mixture and of the company/undertaking	There should be identified producer, uses of the substance/mixture, details of the supplier and the SDS and references to emergency information services as emergency telephone number.
2. Hazards identification	In this section should be found the classification of the substance or mixture, label elements and other hazards.
3. Composition/information on ingredients	This chapter should include identifying information of the substance or the mixture.
4. First aid measures	First aid measures are described here as well as most important acute and delayed symptoms and effects and indication of any immediate medical attention and needed special treatment.

5. Fire fighting measures	Section 5 includes extinguishing media, special hazards arising from the substance or mixture and advice for fire-fighters.
6. Accidental release measures	Here is provide information of personals precautions, protective equipment and emergency procedures as well as environmental precautions, methods and material for containment and cleaning up and reference to other sections if needed.
7. Handling and storage	Subsections are precautions for safe handling, conditions for safe storage, including any incompatibilities and specific end use(s).
8. Exposure controls/personal protection	Control parameters and exposure controls are included in this section.
9. Physical and chemical properties	There is information on basic physical and chemical properties and other information.
10. Stability and reactivity	Here is identified reactivity, chemical stability, possibility of hazardous reactions, conditions to avoid, incompatible materials and hazardous decomposition products of/with the substances or the mixtures.
11. Toxicological information	This section contains information of toxicological effects of the substance/mixture.
12. Ecological information	Ecological information consists of toxicity, persistence and degradability, bio accumulative potential, mobility in soil, results of PBT and vPvB assessment and other adverse effects of the substances/mixtures.
13. Disposal considerations	Here are described applicable waste treatment methods of the substance/mixture.
14. Transport information	This includes UN number, UN proper shipping name, transport hazard classes, packing group, environmental hazards, special precautions for user and transport in bulk according to Annex II MARPOL 3/78 and the IBC Code.
15. Regulatory information	Here is safety, health and environmental regulations/legislation specific for the substance or mixture and chemical safety assessment.
16. Other information	

6.2 Chemicals and safety at construction site

Management of occupational safety in construction industry is more difficult than in other lines of business because there is many directions operating in the projects, conditions are changing all the time along the project and there is

working employees from several companies in same workplace at the same time. Main realizer of a construction project is in charge of occupational safety concerning also chemical management. Good planning and co-operation between actors in a project are essential to maintaining good level of occupational safety.
/23/

6.2.1 Chemical types

Common chemicals and working stages where are used chemicals at construction sites are listed in Table 4. There is also told harmful substances of the chemicals and occupational safety aspects related to the chemicals. In this list is not presented chemical waste types that are generated in demolition works because power plant construction does not usually involve demolition.

Table 4. Common working stages and chemicals and their occupational safety aspects at construction site. /23/

Working stage / Used chemical type	Harmful substances and occupational safety aspects
Concrete works, casting, grinding	Causes dust No significant health hazards
Masonry, brickwork	Alkaline plasters irritates skin and airways and cause allergic rashes Have to use gloves
Spreading of fillers and plasters	Skin and airways irritation and allergic rash Good ventilation and protection masks
Cleaning work	Can be dusty work Gloves needed and often also protection mask
Insulating work	Glass wool may cause fibre dust Dust can be prevented by using covered and fitted products and doing works outdoors as much as possible Gloves and if dusty then protection mask needed as well
Wood works	Wood dusts cause irritation of airways and nose cancer Good ventilation when wood dust is generated

Bitumen and water insulating substances	Hot bitumen vapours can cause airways irritation Should be good ventilation Must use gloves
Acids	Masonry surfaces are cleaned from plaster with 4-8 % hydrochloric acid (HCl) Acids irritates skin and acid vapours irritates eyes and airways Have to use gloves and protection mask
Welding	Welding vapours may cause cancer Should be good ventilation, welding helmet or goggles, heat-resistant gloves Hearing protection recommended when welding stainless steel
Jointing materials, fillers	Safe handling instructions from safety data sheets Skin protection preventing allergic rashes
Adhesives and glues	Some of them includes harmful substances like organic solvents Good ventilation, always have to protect skin, gloves
Alkyd paints and other solvent based paints	Can cause skin irritation, headache, nausea, dizziness and in long exposure even damage to the nervous system Skin protection, efficient ventilation, respirator and gloves are required in painting work
Epoxy paints and coatings	Can cause skin allergies and also dizziness, nausea, irritation and even damage to the nervous system Skin protection and gloves to prevent allergies, efficient ventilation and respirator needed if long-lasting work
Urethane paints and coatings	Includes small amounts of substances irritating airways Skin protection, efficient ventilation and respirator are needed
Waterborne paints	Health effects are insignificant compared to solvent paints Sufficient ventilation and gloves, in some cases also respirator is needed
Acrylic coatings	Some components can be irritating Skin protection to prevent allergies, good ventilation and respirator
Solvent based thinners, detergents and cleaners	Dries skin, causes allergies, dizziness, tiredness and chronic nervous impacts Protection of hands and respirator Usage of solvents should be avoided

Carcinogenicity substances in construction industry	E.g. asbestos, welding of stainless steel (chrome, copper) chromatics in painting, arsenic in pressure treatment wood Asbestos is problematic in demolition but the exposure levels of the other substances are quite low
Sensitizing substances	E.g. epoxy glues and paints, urethane sealants, acrylic coatings More information in safety data sheets of the substances
Chemical storing at construction site	Paints, adhesives, fillers, solvents...etc. and wastes including these substances Should be stored in locked place Monitoring that storing amounts are appropriate (fire risk), incompatible substances separately, flammable liquids apart from explosives, acids and toxic substances Storing should be arranged according instructions in safety data sheet

6.2.2 Risk assessment

EU Directive 98/24/EC is required risk assessment in workplaces. In risk assessment is collected information about risk factors in work environment. Risks are identified and the importance of the risks is assessed. There is also found out how to remove the risks. The management of chemical safety is one part of risk assessment in workplaces. /23/

Employers have to have sufficient knowledge of characteristic and the dangerous nature of the chemicals in workplaces. The exposure levels of employees have to be assessed. Exposure level of employees is depending on the nature of chemicals, the usage amounts and the operational conditions. In workplace should be taken on account also the fire and explosion risks, environmental hazards and potential greater accidents and disasters caused by the chemicals. /23/

Important source of information are labelling markings in chemicals packages and the SDSs of the chemicals. The SDSs should be provided of the chemicals used in the workplaces.

When risks are identified it is easier to start counter-measures to reduce the unwanted risks. Here is presented aspects and expedients to reduce chemical risks:

- Chemical purchase practice
Aim is to use as safe chemicals as possible. Dangerous chemicals should be changed to less harmful ones.
- Guidance, education, motivation
To motivate, educate and guide work managers, supervisors and employees of proper handling and the SDSs of the chemicals and increase their knowledge about chemical safety.
- Storing and fire prevention
Incompatible chemicals keeping separately, monitoring of amounts, conditions and suitability of storing, provisions against possible leaks, knowledge of flammables as well as groundings, smoking and fire fighting equipments should be taken on account
- Tidiness and regular cleaning
Tidiness is prerequisite for safe and efficient work performance. It reduces emissions and exposure of employees.
- Working practices, ventilation
There should be used good and acceptable working practices at workplaces.
- Emissions
Operations close to emission source, purification of emissions, emissions monitoring and risk management of random emissions.
- Protection equipments
Procurement practices of personal protective equipments are reviewed. Equipments should be suitable and the proper usage, cleaning and maintenance should be known by employees.
- Monitoring exposure levels
Measuring exposure levels and decisions of exposure reduction based on them. /23/

6.2.3 Instructions for chemical handling and storing

The safety data sheets are essential sources of information when planning chemical management in workplace and preventing hazards. Handling and storing has to be arranged according the information provided in SDSs. The information for handling and storing the chemicals are in section 7.

If suppliers are not providing SDS of the chemical for some reason, another good information source are International Chemical Safety Cards (ICSCs) if the chemical agents of the chemical product are known. ICSCs are WHO coordinated chemical safety program IPCS (International Programme on Chemical Safety) in collaboration with EU. ICSCs provide information for hazards of the chemicals, the first aid and fire fighting measures related to them and information for precautions for spillage, disposal, storage, packaging, labelling and transport. There are also instructions for preventive measures. ICSCs are available in Internet and they are provided in many languages. They may be downloaded in English form from ILO web site. /28/

6.3 Hazardous waste

Hazardous material originated from building operations includes among others waste oil, solvents, other waste (for example certain seals) that includes solvents, paints, varnish and waste glue, used accumulators, fluorescent lamps, polyurethane insulators, waste including CFC and asbestos. /24/

6.3.1 Waste oils

Waste oils are used oils that must be disposed of or treated and re-used. It includes spent automotive lubricating oils and industrial oils. The primary environmental concern regarding waste oils is that the oil can be contaminated either during use or external sources. The presence of these hazardous contaminants presents a problem for re-using the oils. /20/

Waste oil is unique waste material because there is a significant market demand for its recycling and reuse. Remarkable savings can be realized by using fuels

recycled from waste oil. The recycling and disposal practices of waste oil include recycling to produce fuel, rerefining and combustion to produce energy. /20/

When recycling of waste oils all treatment techniques for processing waste oils to fuel do not effectively remove trace metals. In rerefining is possible to produce a product with characteristics similar to virgin lube oils. Rerefining is not so common recycling method for waste oils because of the demand for waste oils as fuel. In combustion waste oils are generally used in commercial boilers, space heaters or as a supplementary fuel in industrial boilers. Boilers can emit toxic constituents to atmosphere as well as generate fly ash that may contain trace metals other contaminants. The residual ash of boilers is often regulated as a hazardous waste. /20/

7 PRESENT STATE OF WASTE AND CHEMICAL MANAGEMENT ON POWER PLANT CONSTRUCTION SITE

Wärtsilä operates on a power plant construction site complying with local national laws, rules and requirements. These national regulations have to be found out in the initial stages of power plant construction project by site management team. The level of environmental protection and regulation varies greatly between countries where Wärtsilä operates in. Wärtsilä project and site teams should operate at site in as pro-environmental way as they can or be sensible to the prevailing circumstances. Generally environmental regulation is becoming stricter. Hence, Wärtsilä's customers' requirements are also increasing concerning environmental issues all along. This puts pressure on Wärtsilä to meet or exceed the requirements. Showing consideration for the environment is a part of high quality business activity /30/.

7.1 Power Plants construction site process

More and more of Wärtsilä's power plant projects are situated in developing countries because there is demand for them. Developing countries need power plants in order to grow their industry. This puts challenges to keeping the quality and environmental issues on the same level no matter where the project is situated.

Nevertheless there is always some kind of adapting to local conditions because usually some number of subcontractors' workers is locally hired. Without exception projects' workers consists of people from many nationalities and the level of considering environmental and safety issues are varied between people. That's why the safety orientation and training of Wärtsilä employees and subcontractors is important. The HSE guideline is required that all new Wärtsilä employees have adequate orientation to site work procedures, tools, equipments and hazards. It is the site management's responsibility to ensure that all new employees get safety orientation /38/.

Construction starts with civil works. In excavations the top layer of soil is removed. It depends on the type of the soil how deep excavations are. Clayey soil is not so well-bearing bottom and it has to be removed deeper. Then is started the reinforcement and the casting of foundations. First part of the whole construction work is just excavation and foundation works also called works under zero-level.

When foundation works are in a good stage the erection works can be started. Soon is started the frame erection of engine hall and building of storage tanks which requires lot of welding. In addition plumbing and construction for fire fighting systems have to be done. The engines are placed in their positions after engine hall is fairly ready.

Electrical works and pickling are one of the last works in construction before commission stage. In pickling the water and steam circulation systems are chemically cleaned internally with acid, usually with citric acid /22/. In commission phase all equipments of the power plant are tested to ensure that everything is operating in the right way.

The last is the site demobilization which is done according to the demobilization plan created by Site Manager together with Section Managers. Subcontractors clean out all their temporary structures, debris and site facilities. Temporary septic tanks are emptied, dug up and removed from the site. The site is cleaned. If there is unused surplus material it is usually sold to the customer or the subcontractors. Hazardous waste has to be delivered to the hazardous waste treatment plant. /42/

7.1.1 Responsibilities

Responsibilities of environmental issues at the site are agreed in the contracts. Sometimes the soil can be contaminated in earlier operations at the site especially if there has been industrial activity for a long time. The responsibility for the decontamination of the soil is agreed in the contract between Wärtsilä and the customer. Customers are usually in charge of the suitability of the location to construct a power plant.

If it is needed an environmental impact assessment before project starts, the responsibilities are agreed in contracts with customer. Nowadays governmental institutions or financiers often require an environmental assessment of the environmental impacts of planned large constructions projects. Environmental impact assessment (EIA) helps to assess the risk the project poses to the environment. In addition, EIA is a tool to deal with social aspects of the projects. In EIA the residents of neighbouring areas are given information of the project and they also have opportunity to affect it. /22/

Wärtsilä has many subcontractors working at the site. The subcontractors can have also subcontractors. It is important to ensure that the subcontractors operate according to the Wärtsilä way of working. Wärtsilä's subcontractors are responsible for operating according contracts between Wärtsilä and them. Wärtsilä's Site Section Supervisors are responsible of watching over that the principals and agreements of Wärtsilä are implemented at the site also concerning the environmental issues.

7.2 Instructions

In Health, Safety and Environmental Plan –document is collected main instructions concerning HSE issues at Power Plants' sites. HSE Plan is a part of Site Handbook which includes all necessary instructions to site working. The Site Handbook is available at all Power Plant construction sites. All Power Plants sites should have their own health and safety plan. It should be modified according to local regulations /32/.

All Wärtsilä employees should know what instructions are available and where before site working. The HSE Plan requires that Wärtsilä personnel, including subcontractors, should be trained to understand the HSE hazards, requirements and controls associated with the duties they perform. The senior management and advisors are required to get training about HSE risks related their tasks. The training consists of followed headings:

- Basic education and training

- Wärtsilä's environmental policy
- Main principals of the environmental system
- Health and safety issues
- Storage and handling chemicals
- Waste and hazardous waste management
- Instructions for emergency situations
- Taking care of environment /32/

Occupational Health, Safety and Environmental (HSE) Guideline for construction and installation works –document gives more specific instructions related to occupational HSE management. There is presented safety routines at site that consisting of safety committee, safety meetings and weekly site inspection. In addition there are instructions for Lost Time Injury (LTI) and accident/near miss reporting. In Protecting the environment –paragraph is said that the construction site shall be kept in good order and oils and chemicals shall be stored properly. /38/

The Site Quality Assurance Documentation Set (SQAD) is an important part of Wärtsilä management system of construction. SQAD is a complete package containing needed software and hardware components on sites. The SQAD contains project-specific documents, among others installation instructions, empty tests and inspection forms which are to be filled with inspections and test results on the site. There are also forms and instructions concerning HSE issues at site.

Wärtsilä has Risk Identification –tool which has implemented according OHSAS 18 001 management system requirements. Risk identification and assessment is made concerning local site circumstances and Wärtsilä's role in power plant construction project. There is identified all hazards during the construction process of power plant including also chemical risks. /39/

7.3 Waste management

There should be reserved enough room and containers for waste management at construction site. Waste management should be planned beforehand. Every working section where is generated waste should have waste containers close to their working area. In Wärtsilä Power Plants construction sites is generated typical construction waste. Wastes that are specific for power plant construction are waste chemicals from pickling and flushing.

7.3.1 Sorting of waste

The recycling of waste both saves natural resources and provides economical benefits. Continued waste treatment and recycling is not possible without proper sorting. Most of the properly sorted When waste sorting is planned, first has to found out what kind of waste management regulations the country has where the constructions site is situated. After that has to found out what regulations local municipality and local waste management company have. They can have more strict regulation of the waste management and sorting than the general laws are.

The reason for various local regulations is often that the method of disposal differs. Somewhere the only option is to put almost all waste to landfill, somewhere there are arranged recycling and recovering possibility for every waste type that is possible. If the disposal method is incinerator then usually combustible waste is collected as a separate fraction. To this combustible waste should be sorted for example some of the plastic wastes (not PVC plastic), polystyrene, cardboard and paper (if not collected separately), kitchen paper and textiles.

In my opinion if the site is situated in a country where there are no regulations of sorting waste, still at least wood, metal, hazardous waste and mixed construction waste should be sorted out at the site because then the waste fractions are easier to get recycled. Hazardous waste should every time be sorted out from other wastes and stored properly. There are many countries where the level of environmental legislation is really on an early stage compared to Europe. There the site team

should find out the nearest acceptable waste treatment plants and companies and deal with them.

In developing countries wood and metal and other sorted fractions are readily recycled and reused because there is often scarcity with raw materials. But it depends on country what material is easy to recycle and what is not. For example in the site Farcha II in Chad there was demand for wood material that was used as construction material or firewood. Somewhere else wood could be problematic to get recycled.

The site in Chad was spacious and there was enough room for waste collecting. There was collected wood waste, mixed construction waste, metal and hazardous waste. Wood waste was easily got recycled. There was operating also local waste management company that could deal the non-reusable waste.

Sorting is more problematic on confined construction sites and there should be paid attention to good waste management planning. The waste management should be planned carefully in order to make waste handling fluent and functional



Figure 5. The module is packed in a wooden box and covered with a plastic coating. /17/

from the very beginning of the project. It is important to prevent waste containers from overflowing with good planning. Most common waste fractions of power plant construction site are presented in the next chapter.

7.3.2 Waste types

The most outstanding part of the waste generated at a construction site of power plant is coming from packaging material when mineral waste is not included. Therefore the waste differs from ordinary household waste and also industrial waste. Elements and parts of power plants are usually packed in wooden boxes. In Figure 5. and 7. are presented typical packaging containers and boxes at the site. Wood is the most significant share of packaging waste on a power plant construction site. Some waste fractions are generated at the site so little or not at all so they are not listed here. For example glass and bio-waste is not generated nearly at all. If eating is arranged at site facilities bio-waste can be generated, but it is not typical construction waste. Organic waste has to be sorted out if organic waste collecting is arranged by a local waste management company. Otherwise it can be sorted to mixed construction waste.

The most common waste types on the power plant construction site according project Centrale de Farcha II are presented in the following:

7.3.2.1 Mineral waste

Mineral waste consists of ground masses and rocks from civil works at the site. As typically in construction sites definitely the prevailing waste type formed at the power plant construction site is mineral waste. At the site first it is considered if there is use to the generated mineral waste in secondary fillings. Normally it is not difficult to discover where the masses would be deposited if it is not contaminated soil. Usually there is found use or place to the mineral waste easily for example as ground fillings.

7.3.2.2 Wood waste

At the site wood waste consists of wood boards, wooden boxes, plywood boxes, drums, pallets, nailed wood...etc. Most of this waste is coming from packaging material. The elements of power plant are usually packed in wooden boxes which protects the products inside. One part of wooden waste is also coming from foundation works where wooden frames are used. If mineral waste is not counted in, wood waste is the most significant part of the construction waste.



Figure 6. This wood material is come mainly from radiator packages. /17/

Considerable single wood share of the total wood packaging material is coming from radiators packages. One radiator packaging material weights slightly over 3600 kg and it accounts about 44 % of the weight of the total weight of radiator and package. There is needed several radiators at power plant site. In Figure 6. is shown how huge amount of wood material was generated mainly from these radiator packages at the site in Chad. Clean wood is quite easy to get recycled, but it depends on the location of the site.

7.3.2.3 Metal

Metal waste includes at the site for example residue of reinforcement iron and iron elements, nails, coated electrodes, empty paint cans, metal straps, metal package material...etc. The main reason why metal waste is quite small part of the total waste amount at the site is the usage of prefabricated units in construction. Metal waste is coming from residue from construction works and package material.

Materials are shipped to the construction sites using 20 and 40 feet. These containers should also be removed from the site after they are empty. Containers are usually not perceived as waste because they are usually sold. Management of containers depends on if the containers are included in the project transport agreement, contract with customer or some other option. /36/

7.3.2.4 Mixed construction waste

Mixed construction waste includes all rest construction materials that cannot be recycled as glass wool, polystyrene...etc. This fraction is collected to its own container and goes usually to landfill if there is no waste incinerator nearby when most of these materials can be sorted to combustible waste fraction and got to energy recovery.

7.3.2.5 Plastic waste

Plastic waste contains plastic tarpaulins, plastic straps, plastic tubes and plastic bottles. If it is not possible to recycle plastic waste it can be collected with mixed construction waste. Plastic tarpaulins have been quite easy to get sold or reused.

Nowadays modules as engines and generators are covered with tarpaulins which are made from PVC plastic /33/. Earlier the generators were packed in wooden boxes as well. This change has reduced the volume of wood waste.

7.3.2.6 Cardboard

Cardboard is also common packaging material also in power plant construction site. In cardboard fraction are included pasteboard packages, corrugated cardboard, cardboard boxes, cartons...etc. There should be reserved container spacious enough for cardboard waste because it is generated in considerable amounts by volume on site.

7.3.2.7 Septic waste

Septic waste means waste water collected to a septic tank. There are often temporary septic tanks during the construction time on the site. Septic tanks should be emptied when tanks are becoming full. At the end of the construction project those temporary tanks should be emptied, dug out and transported away. /42/

7.3.2.8 Paper

Paper is generated slight amounts in the site office where should be placed receptacles for it. In paper fraction there can be sorted white and coloured paper, newspapers, magazines...etc. Confidential papers should be handled in a proper way.

7.3.2.9 Hazardous waste

Waste oil, paints and varnishes, solvents, PCB-containing sealants, adhesives, batteries and accumulators, acids,



Figure 7. Typical wooden boxes including materials needed in power plant construction site.

/17/

transformers and capacitors containing PCB ...etc. are common examples of hazardous waste generated at the construction site. Each hazardous waste type should have its own separate waste receptacles. Best way is to store them in their original packaging receptacles. Hazardous waste should be stored in a locked place. Waste paints, varnishes and glues that are completely dry can be disposed to landfill.

7.3.3 Amounts of waste

Considerable amount of waste in construction sites is coming from packaging material. Wärtsilä has many producers who manufacture all parts that are needed to construct a power plant. Producers pack material usually in wooden box and then boxes are loaded in containers.

Table 5. presents package material calculation based on Wärtsilä power plant construction project Centrale de Farcha II in Chad. When this was calculated, most of the material shipments had already come to the site, over 95 % according Logistic Coordinator of the site. The information for the calculation is collected from packing lists of the deliveries. Packaging material amount is based on calculations but it is still an approximation because packaging material is not always declared in shipment information. The package material amounts can be different in different type of power plant projects, for example in gas power plants.

Almost 300 tons of packaging waste is generated in this 7 engines power plant project. Certain standard containers are used for shipments: 20 feet and 40 feet long steel containers. These containers are common in sea freights while in airfreight these containers are usually not used. The amount of containers in Farcha II was: 44 pieces 20 feet containers and 148 pieces 40 feet containers, in total 199 containers. The number of containers depends on the size of the project, but a rough estimation is that there are 20-25 of 40 feet containers per engine /38/.

It was estimated at the site that 90 % of the total amount of packaging material is wood, 9 % metal and 1 % plastic, cardboard and paper by mass. However wood is

absolutely the most common share of the packaging waste followed with metal and other materials.

Table 5. Package material amount in tons in Wärtsilä project Farcha II (7 engines).

Delivery	Gross weight /t	Package material without containers / t
Sea freight	3957	288
Airfreight	54	7
Total	4010	296

The mineral waste is prevailing waste type on power plant construction site. Usually approximately 0,1-0,5 m deep layer is removed from the surface of ground of the building area. This causes thousands cubic meters of mineral waste. Anyway, it is usually easy to find use or place to the mineral waste generated at the site.

7.3.4 Packaging material

Long transporting distances and also in some cases long storage time at construction site puts challenge to quality of the packages. In addition that is why there have to be used considerable amount of packaging and filling materials in protecting the goods.

Wärtsilä Power Plant projects require that goods are packed in seaworthy packages. They have to also be stackable and it should be possible to handle them with forklifts. Packaging and filling materials should be primarily re-usable, biodegradable, and of non toxic materials. If packaging material is classified as hazardous waste the supplier should arrange return transports for the materials.

/33/

Storage on power plant construction sites requires humidity and anti-corrosion protection for the goods which must be sufficient for minimum 12 months from delivery of the goods. Wooden packaging material must be in accordance with

standards ISPM 15 (International Standards for Phytosanitary Measures, Publication 15, FAO). The supplier should pay attention to the final destination country mentioned in the shipping mark and to the means of transportation and duration of storage, and pack and protect the goods according these conditions.

/33/

Goods are normally packed to containers which are usually owned by Wärtsilä Finland Oy Power Plants in Wärtsilä power plant projects. A container actually is not a transport packaging but a load space for transporting cargo. The load should be evenly distributed in the container. If there is empty room in the container after the supplier has loaded all packages, the supplier should estimate the empty volume and inform it to responsible Wärtsilä Power Plant logistic coordinator.

/33/

7.4 Chemical management

Chemical management consists of the information management of chemicals and handling, storing and disposing of the chemicals according instructions on Wärtsilä power plant construction sites. Chemicals are handled wearing sufficient personal protective equipments. The working procedures and instructions of SDSs are followed. Most of the chemical types at the site are common construction chemicals but there are also chemicals specific for power plant construction, for example pickling chemicals. On site should be ordered exact amounts of chemicals to avoid surplus because many of the chemicals used construction are counted among hazardous chemicals and their disposing is more complicated than ordinary waste.

7.4.1 Chemical types

A part of the chemicals used at the power plant construction sites are typical construction chemicals. They are used among others for finishing, cleaning and sealing. These chemicals are paints, hardeners, adhesives, sealants, detergents, fillers, silicone seals...etc. The earth-movers and other vehicles used at construction site consume fuel and lubricants. Some of them need also hydraulic

oils. Construction of power plant's tanks need lot of welding so there is also considerable amount of welding gases for example oxygen, argon and acetylene.

Pipelines of power plant have to be cleaned before operation. Cleaning of pipe systems is prerequisite for the trouble free operation of the power plant. Different systems need different cleaning. Cleaning methods include pickling, mechanical cleaning, cleaning with compressed air, washing with alkaline solution in hot water, sand-blasting and flushing with lube oil/light fuel oil/water. There is needed certain types of chemicals. /34/

In commissioning phase are used chemicals that are used in operation of power plant, because in that phase is tested if the power plant is working as it should. In that phase there is used for example oils, insulating oils, some water treatment chemicals as activated carbon and coagulant...etc.

7.4.2 Pickling and flushing

Pickling removes rust, slag weld, spatters and other dirt from the pipes. First pipes are filled with an acid solution of 6-8 % citric acid ($C_6H_8O_7$). Citric acid is the most common pickling acid used at Wärtsilä construction sites. Other possibilities are hydrochloric acid and phosphoric acid, but pickling with citric acid is the recommended option. /34/

Pickling time varies depending on how rusted or dirt pipes are. Then the pickling solutions is blown away with compressed air and rinsed with hot water and blown again. At last pipes should be rinsed with neutralizing solution (anti corrosion inhibitor), for example solution including 1 % Caustic soda. /34/

Flushing removes from the pipelines all debris and foreign material, which could damage engines or auxiliary equipments. To perform the flushing at the site, movable flushing system has to be built up which includes pump, tank, heater and filter. In flushing is used lube oil, light fuel oil or water depending on what power plant system is flushed. /34/

7.4.3 Chemical handling and storing at the site

When handling chemicals there should be followed instructions of SDSs and worked with consideration. Chemicals are kept in their own containers and their labels clean and readable. Containers should be closed and locked when chemicals are not needed. Containers of chemicals especially flammable chemicals should have “no smoking” signs. Hazardous chemicals should be stored in ventilated and separated container or building away from direct sunlight and heat. The storage container or area should have basins where possible leaks can be collected and easily monitored. /31/, /38/, /32/

Personal protective equipments (PPE) should be provided for and worn by all employees. Personal protective equipment should be appropriate especially when handling chemicals. The PPE should be selected based on the identified hazards, the specific work, the duration of exposure, regulatory exposure limits and the individual employee. /38/, /32/

7.4.4 Oil and chemical spills

Oil or chemical spills can be caused by motor vehicles, construction chemicals or storage containers during construction time /32/. Common reason for oil spills is in commission phase especially when plumbing and lines of the power plant are filled first time. When starting fillings pipe connections may be not tighten or there is malfunction in the system or valves can be loose or be in a wrong position /16/.

Site personnel are responsible for preventing spills at the site. When noticed spill or leak of oil or some other chemical it have to be reported to Site Manager or HSE responsible immediately. The followed information should be gathered as soon as possible: seriousness of spill, estimation of the amount of released spill, location of the spill and proposals for control measures. /32/, /16/

Power plant construction site should be equipped with absorption material as precaution for spills. Absorption equipment can consist of absorption material and 200 litres lidded barrels where the used absorption material can be collected and

stored before transporting and disposal /32/. In major spill contaminated soil should usually be excavated from the ground and deliver to waste treatment plant to be disposed or treated /16/.

In power plant area is oily water collection systems which can be with or without oily water treatment unit. Oily water can be collected from storage tank yard, day tank yard, power house, fuel treatment house and workshop's oily water sump to collecting tank. The oily water treatment unit is based on dissolved air flotation enhanced by chemical treatment and activated carbon filtration. Main contaminants in oily water are oil grease, suspended solids and metals. The treated water is meeting requirements and can be disposed to sewer.

If there is not oily water treatment unit then all oily water is collected to a sludge tank that is emptied and transported to disposal. Other option is to incinerate the oil sludge in power plants own incinerator. If spill is occurring in these areas when these systems are built up then there is no need to any actions. Notice that connections from the tank area are normally closed so they shall be opened in case of oil leakage. /32/, /16/

8 IMPROVEMENTS AND SUGGESTIONS TO ENHANCE WASTE AND CHEMICAL MANAGEMENT

This chapter presents the suggestions on improvements developed during this thesis work. One is related to waste management and the other to chemical management at Power Plants' sites. The functionality of these systems will not be seen until at practice in Power Plants. Nevertheless always the best way is to improve the level of employees' knowledge of the environmental aspects.

8.1 Waste management plan

In the beginning of the project was considered if there could be some general waste management plan that would be used in all Wärtsilä power plant construction sites. At the site in Wärtsilä personnel opinion it would have been impossible to develop waste management plan that could be functional in all Wärtsilä sites because sites differ from each other so radically.

This waste management plan developed during this thesis project is a template for construction sites of Wärtsilä Power Plants and it have to be modified according the local conditions of the sites. The Waste Management Plan form is in Appendix 1 with instructions.

Waste management has to be planned beforehand before construction activity starts at the site. Of course the operation of waste management changes along the site activity but the plan should be updated accordingly. The Waste Management Plan should be updated if there happen something that changes the waste management from the described activity.

At the very beginning of the project there is generated mainly mineral waste from the excavations of foundation works. At the time when the most of the material containers are coming to the site there starts to generate various waste materials when packages are opened and lot of package waste is generated. These changes should be perceived in waste management planning.

In the beginning of a project the HSE responsible/Site Manager is responsible to make the waste management plan for the site. The HSE responsible/Site Manager with other Section Managers all together should decide suitable area for waste collecting at the site. The location has to be planned in a way so that the waste is easy to carry out from the site but at the same time the area shouldn't be on the way of the other operations on the site.

Also they have to discuss about sorting practices and provide containers for each waste fraction. They have to take on account national regulations when planning the waste management. There should also be found out local waste management company's contact information and how in that area the waste sorting is arranged.

In this plan they also have to decide arrangement for waste handling at the site. Every working section should have some kind of waste receptacles or containers close to their working area. The waste receptacles should be emptied regularly to the waste collecting area in the site.

In addition they have to think in waste management plan how to handle hazardous waste. Hazardous waste should be storage in a lidded receptacle in a locked container. Best way is if it can be stored in the original receptacle because in the receptacle there is all needed information of the hazardous waste. The storage container or area of hazardous chemicals should have basins where possible leaks can be collected and easily monitored. Empty receptacles can be sorted to other waste fractions. For example empty paint pots can be sorted often to metal or landfill waste.

This waste management plan should be saved in Wärtsilä internal document management database IDM and placed with its appendices at the construction site where employees can see it for example to bulletin board or notice board. The waste management plan template will be available in the SQAD.

8.2 Chemicals list of Power Plants

During this thesis work was collected chemicals list of the chemicals that are used in Power Plants construction sites. This list is based on Centrale de Farcha II –

construction project and it does not give a whole picture about Power Plants chemicals. The work is still going on and this chemicals list is like template where all Power Plants chemicals can be collected.

The purpose of this list is to enhance chemical management at the construction sites. In the HSE plan is said that the SDSs should be available at the sites. Collecting of them has been the responsibility of the HSE responsible of site or Site Manager. It takes some time to take contact with the manufacturers or importers of the chemicals used on site and ask the SDS from them. And however many of the chemicals are exactly same no matter what kind of project especially those which are in Wärtsilä scope of delivery. The objective is that Site teams can find the chemicals and their SDSs from this list. This general chemicals list would save time and make it easier to find the needed information of the chemicals. From there the SDSs are easily printed out to the site.

This chemicals list is involved in the SQAD. One version of the list is also added to Wärtsilä intranet Compass in the Chemical registry -website where information is provided on Wärtsilä's chemicals and also chemicals list of other Wärtsilä departments. In Figure 8. is shown part of this chemicals list saved in Compass.

This list includes chemicals product name, description, importer/manufacturer of the chemical, dates of SDSs, links to SDSs, hazard symbol capital, R- and S-

COMPASS a- | a+ Show content for -

News & Events Products & Solutions Operations Business Support Workspaces People

Luomassa > Työsuojelu > Vaasa & Ransor > Ohjeet

No:	Chemical product name	Description	Producer or importer	EN MSDS	EN Date	FI MSDS	FI Date	Hazard symbol	Risk phrase	Safety phrase	H-statement	P-statement	Const
1	3442 Casco Flex	Adhesive	Alko Nobel Coatings Oy	DBAB917434	2008	DBAB920215	2008	—	—	S2,29			X
2	3880-00001 Casco Contact, vesiohenteinen	Waterborne contact adhesive	Alko Nobel Coatings Oy	DBAB917620	2010	DBAB920219	2003	—	R52/53	S2,29,60			X
3	3914-00001 Casco Akustoseal	Acrylate copolymerbased sealant	Alko Nobel Coatings Oy	DBAB920205	2004	DBAB920232	2003	—	—	S2			X
4	Activated carbon, Aktivihili	Absorbent	Wärtsilä Sweden AB	DBAB920192	2008	DBAB920239	2008	—	—	—			
5	CP 620	Firefoam	Hilti Ltd.	DBAB920187	2007	DBAB979180	2003	Xn	R20, 36/37/38, 42/43	S2,23,24/25,36/37/39,45,51			
6	Empire	Alkyd paint	Tikkurila Oyj	DBAB920184	2008	DBAB920242	2008	—	R10	S2,23,46,51			X
7	esco PDV Salt	Salt	esco -european salt company GmbH & Co.KG	DBAB920181	2004			—	—	—			X
8	Fonteccoat FL 100	Epoxy paint	Tikkurila Oyj	DBAB920177	2010	DBAB920245	2010	Xi, N	R36/38, 43, 51/53	S23v,24,26,29,36/37/39,51			X
9	GHL 300-2950	Cast resin, used in cable joints	ABB Ab	DBAB920169	2010			Xn	R20, 36/37/38, 42/43	S23,24,26,37,45			X
10	Hardener 008 4042	Hardener for Fonteccoat FL 100	Tikkurila Oyj	DBAB920162	2010	DBAB920253	2010	Xi, N	R36/38, 43, 51/53	S24,26,29,36/37/39,51			X
11	LUJA pintamaali, puolinimessä ja puolikittävä	Acrylate latex paint	Tikkurila Oyj	DBAB920158	2008	DBAB920257	2008	—	—	—			X

Figure 8. Part of chemicals list of Wärtsilä Power Plants in Wärtsilä Compass intranet.

phrases, H- and P-statements (if exist), and mark is it used in construction or commission phase at site. A part of his chemicals list is seen in Appendix 2. In addition there is instructions of the list and how there can be added missing chemicals used in Power Plants. There is also presented the new hazard symbols and statements according CLP Regulation.

8.3 Suggestions to enhance waste management

Here are collected suggestions to enhance waste management at the Wärtsilä power plant construction sites. All of them come up during this project. These suggestions are collected for Wärtsilä personnel who can consider if some of them are feasible.

8.3.1 Cleaning at the site

From site point of view continuous problem is low cleaning activity at sites. It is really serious problem because it concerns not only waste management but whole construction site's safety. Tidiness and well performed cleaning promotes safety and accessibility at site and prevents accidents.

One suggestion to enhance this situation is to write clear sum of money in contracts made with subcontractors that covers the cleaning. This would be guarantee that the cleaning is done satisfactory. If cleaning is done badly then Wärtsilä could sell the cleaning work to other doer. This suggestion came up from the site personnel.

In Wärtsilä occupational HSE guideline is said that "It is possible to add to the site rules that if the contractor does not maintain housekeeping, Wärtsilä (as Principal) has the right to order third party to clean the area during and after work at the Contractors expense" /38/. Maybe this text should be written in official contracts with subcontractors if the first suggestion to improve cleaning at site is impossible.

8.3.2 Waste management and HSE in contracts

Another suggestion related to waste management is that the responsibilities of waste management and also other HSE issues should be more clearly in contracts with the customers. Sometimes customers are responsible of waste disposal. In these situations it should be also ensured that the waste management is planned beforehand and managed carefully with customer. These things should be clear from the beginning of the projects because then the responsible one can ensure that the waste management is properly arranged from the beginning of the construction project. It is important that waste management is functional from the start to the end of the project. Unclear situation makes planning of waste management difficult and delays the decisions concerning waste management.

8.3.3 Information in packing lists

In waste management planning is important to know what kind of material is coming to the construction site because it helps to make preparations for packaging material handling. With some modules comes especially long or much wooden packaging material and it is good to be prepared to handle them. In this situation advance information about materials coming to the sites is really worthy.

Packing lists are source of information of the packages and goods coming to the construction sites. In packing list supplier is described the content of the supply. Final packing list is sent to the responsible logistic coordinator when goods are ready for delivery. /33/

One suggestion to improve the provisions for packaging material handling at construction site is that suppliers should inform in the packing lists more detailed about packaging material. Some suppliers are already informed the amount of packaging material in the packing list. But it should be required that every supplier should provide information of the amount and type of packaging material in the delivery. There should be informed what the packaging material is, whether it is wood, plastic, metal, cardboard or something else. This would help site team to make pre-arrangements to handle material coming to the site.

8.3.4 Waste collecting area and safety signs

One thing that should be taken on account is the room preserved to waste collecting area in initial state. At the site there may be little possibilities to manage waste collecting and material storing properly if there is not preserved room enough. The room needed for waste collecting area and storing of material containers should be sufficient for the operations. If it is possible this need for the room should be taken on account already when planning and agreeing the conditions of the construction site or in layout design of the site.

In Wärtsilä is going other project where is defined safety signs in constructions phase at the Wärtsilä Power Plants sites. It would be good if the signs of waste containers for each waste fraction could be taken among the standard signs used at the site.

9 CONCLUSION AND DISCUSSION

The construction site has typical characteristics which puts challenge to the organizing safe and functional chemical and waste management. Along the process of construction the activity and the actors working at the site are changing. This puts challenge to the planning of chemical and waste management at the site. They have to keep up with the changes at the site and communication between all actors should be functional.

Construction of power plant causes less waste than ordinary building. Prefabricated products are used and construction structure is simplified. In addition construction of power plant is new construction site so there is not usually needed any demolition or renovation works. New construction projects cause less waste than projects including demolition or renovation. In new construction projects lots of mineral and packaging waste is generated. In power plant construction site is generating lot of packaging waste because the prefabricated units and goods are well-packaged preventing them not to get broken in long deliveries.

Wärtsilä power plant construction sites can be situated all over the world, more and more in developing countries as well. Challenge is to keep the occupational safety and environmental protection level the same no matter what is the location of the site. Safe working environment should always be the objective at the site. Tidiness and continuous cleaning are main factors when improving site safety as well as appropriate handling of chemicals.

The level of environmental consciousness is depending on the origin and the cultural background of the employees. This puts challenge to the Wärtsilä construction project team to promote environmental aspects among employees at the site. Furthermore safety issues and cleaning are often also cultural questions. More often in masculine cultures these things are underrated and the attitude can be quite careless toward them.

Both waste management plan and Power Plants chemical list are developed to prevent and minimize the hazards and risks on the site. Waste management plan is tool for planning and managing the waste handling at the site. From construction site point of view the Power Plants' chemical list is facilitating the discovery of chemical safety information of the chemicals used at the site.

REFERENCES

- /1/ Directive 2008/98/EC Waste Framework Directive of European Union
- /2/ Directive 2004/12/EC Packaging Waste Directive of European Union
- /3/ Directive 98/24/EC Chemical Agents Directive of European Union
- /4/ European Agency for Safety and Health at Work. Directive 98/24/EC – risks related to chemical agents at work. Accessed 7.12.2011.
<http://osha.europa.eu/en/legislation/directives/exposure-to-chemical-agents-and-chemical-safety/osh-directives/75>
- /5/ EPA's Green Building Workgroup. 22.4.2009. Buildings and their Impact on the Environment: A Statistical Summary. Accessed 11.11.2011.
www.epa.gov/greenguilding/pubs/gbstats.pdf
- /6/ European Chemicals Agency ECHA. 27.5.2009. Guidance on the Application of the CLP Criteria. Accessed 11.11.2011
http://guidance.echa.europa.eu/docs/guidance_document/clp_en.pdf
- /7/ European Chemicals Agency ECHA. 27.5.2009. Questions & Answers on Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures. Accessed 11.11.2011.
http://echa.europa.eu/doc/classification/questions_and_answers_clp_2009_0526.pdf
- /8/ European Commission. 2007. Accelerating the Development of the Sustainable Construction Market in Europe. Report of the taskforce on sustainable construction. Accessed 11.11.2011.
<http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/data/sectors/constructionanddemolition>
- /9/ European Commission. 24.10.2011. REACH. Accessed 11.11.2011.
http://ec.europa.eu/environment/chemicals/reach/reach_info.htm

- /10/ Eurostat. 26.8.2010. Construction and demolition waste. Accessed 11.11.2011.
<http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/data/sectors/constructionanddemolition>
- /11/ Eurostat. 2.9.2011. Packing waste. Accessed 1.11.2011.
http://epp.eurostat.ec.europa.eu/portal/page/portal/wastestreams/packaging_waste
- /12/ The European Union Commission Regulation (EU) No 453/2010 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the REACH
- /13/ The European Union Regulation (EC) No 1272/2008 on classification, labeling and packaging of substance and mixtures (CLP)
- /14/ The European Union Regulation EC 1907/2006 REACH Registration, Evaluation, Authorisation and Restriction of Chemicals.
- /15/ Government Decision on Construction Waste, April 3, 1997. Ministry of Environment, Finland
- /16/ Hautio, Mikko. 2010. Environmental Management Plan for Wärtsilä Power Plants. Thesis. Vaasa University of Applied sciences.
- /17/ Honkanen Hanna-Maija. 2011. Pictures from Wärtsilä Power Plants construction project Centrale de Farcha II in Chad.
- /18/ Johansson Ole. 20.7.2011. Wärtsilä Corporation. Interim report January-June 2011. Power Point show. Accessed 1.11.2011. Available in Wärtsilä intranet.
- /19/ Jussila Jani-Matti. 2010. Rakennustyömaan jätehuollon järjestäminen. Thesis. Tampere University of Applied Sciences.
- /20/ McCabe, M. & Newton, W. 1998. Waste oil. Standard handbook of Hazardous Waste Treatment and Disposal. 2nd Ed.

- /21/ Official Statistics of Finland (OSF): Waste statistics. Helsinki. Statistics Finland. Accessed 11.11.2011. <http://www.stat.fi/til/jate/tie.html>.
- /22/ Piekkala Mikko (2002). Environmental issues concerning planning and constructing Wärtsilä's diesel power plant projects and sites. Åbo Akademi University. Master Thesis.
- /23/ Riala R., Finnlund M., Pylkkö T. & Silvo K. (1999). Rakennusalan kemikaalien turvallinen käsittely. 2nd Ed. Helsinki. Työterveyslaitos. Finnish Institute of Occupational Health.
- /24/ Suomen Kaupunkiliitto & Suomen Kunnallisliitto, Association of Finnish Local and Regional Authorities. 1991. Rakennustoiminnan jätehuolto. Helsinki. Kaupunkientalon painatuskeskus.
- /25/ Thormark Catarina. 2002. Handling and Recycling Building and Construction Waste. Copenhagen: Nordic Council of Ministers.
- /26/ Käyttöturvallisuustiedote. 31.12.2010. Tukes, Finnish Safety and Chemical Agency. Accessed 11.11.2011. <http://www.reachneuvonta.fi/REACH/reach.nsf/sp2?open&cid=content443B7&leftnavinf=FI\Sis%F6\REACH\content4431B7&leftnavinf=o&size>
- /27/ Safety data sheets. 27.12.2010. Tukes, Finnish Safety and Chemical Agency. Accessed 11.11.2011. <http://tukes.fi/en/Branches/Chemicals-biocides-plant-protection-products/Safety-data-sheets/>
- /28/ International Chemical Safety Cards. 2011. World Health Organisation. Accessed 30.11.2011. www.who.int/ipcs/publications/icsc/en/
- /29/ Wärtsilä. 2002. Accessed 1.11.2011. Available in: <http://dml.wartsila.com/dml/Standard/RecordView.jsp>

- /30/ Wärtsilä Finland Oy. 2009. Environmental Guide. Accessed 31.8.2011. Available in Wärtsilä intranet.
- /31/ Wärtsilä Finland Oy. 30.4.2008. Environmental Incident Prevention. Power Plants. Handbook. Accessed 31.8.2011. Available in Wärtsilä intranet.
- /32/ Wärtsilä Finland Oy. 29.10.2010. Health, Safety and Environmental Plan. Power Plants. Construction Site. Accessed 31.8.2011. Available in Wärtsilä intranet.
- /33/ Wärtsilä Finland Oy. 22.12.2009. Logistics instructions for WFI-P Suppliers for Wärtsilä Power Plant Suppliers. General document. Quality Integration File. Accessed 31.8.2011. Available in Wärtsilä intranet.
- /34/ Wärtsilä. 2010. Cleaning and flushing of external piping. Power Plant installation instructions. Accessed 31.8.2011. Available in Wärtsilä intranet.
- /35/ Wärtsilä. 2011. History. Accessed 11.11.2011. www.wartsila.com/en/about/company-management/history
- /36/ Wärtsilä. 2010. Instruction for Managing empty containers at Site. Internal Handbook. Accessed 31.8.2011. Available in Wärtsilä intranet.
- /37/ Wärtsilä. 2010. Material Management. Internal Handbook. Accessed 31.8.2011. Available in Wärtsilä intranet.
- /38/ Wärtsilä. Occupational Health & Safety and Environment guidelines for Construction and installation works. Accessed 31.8.2011. Available in Wärtsilä intranet.
- /39/ Wärtsilä. 13.8.2009. OHS risk identification and assessment at sites. Accessed 23.11.2011. Available in Wärtsilä intranet.

- /40/ Wäertsilä. 2011. Power Plants 2011. Power Point show. Accessed 31.8.2011. Available in Wäertsilä intranet.
- /41/ Wäertsilä. 2009. Project Charter for FARCHA II. Power Plants. Project Charter. Accessed 31.8.2011. Available in Wäertsilä intranet.
- /42/ Wäertsilä. 2010. Site Demobilization. Internal Handbook. Accessed 31.8.2011. Available in Wäertsilä intranet.
- /43/ Wäertsilä. Technical Specification for Farcha II. Accessed 31.8.2011. Available in Wäertsilä intranet.
- /44/ Wäertsilä. 2011. This is Wäertsilä. Accessed 11.11.2011. www.wartsila.com/en/about/company-management/overview

Waste Management Plan

1. Introduction

This document includes instructions of Waste Management Plan that is developed to be used at power plant construction sites of Wärtsilä Power Plants. Purpose is to improve waste management and handling at construction site. Waste management should be functional from the beginning to the end of the project. Waste management should be planned and arranged before the actual construction starts. Waste management is important part of power plant sites operation. When it is well-managed whole work community will benefit. Site is cleaner, more comfortable and safer for all employees.

2. Instructions

The Waste Management Plan should be done before construction operation starts at the site as full-sized. The Waste Management Plan should be filled by every Wärtsilä Power Plant construction site project. This plan helps to take waste management on account from the beginning of project. The Waste Management Plan should be placed with its appendixes at the construction site where employees can see it for example to bulletin board / notice board. Detailed instruction for filling this Waste Management Plan is in the end of this document.

3. Finalising and updating

The Waste Management Plan should be done at the beginning of the power plant construction project. When it is ready it should be placed at the construction site where all employees can see it. Waste Management Plan should also save to project's HSE folder in IDM. If there happen some changes that affects to the waste management of the site the Waste Management Plan should be updated accordingly.

1. PROJECT INFORMATION

Project name and type	
Location	
Site Manager	
HSE Officer / HSE responsible person	

2. WASTE MANAGEMENT COMPANY CONTACTS

Company name			
Address			
Contact person		Phone number	
E-mail			
Disposing method			
Transportation and waste counters			
Possibility to receive hazardous waste			

3. WASTE MANAGEMENT INFORMATION

3.1 Ordinary waste

Waste type	Estimated quantity		Type of waste container	Emptying interval	Possibility to recycle/ reuse on-site or locally (specify recycler and method)	Company of waste disposal	Method of disposal
	Vol (m ³)	Mass (t)					
Mixed construction waste							
Wood							
Metal							
Plastic							
Cardboard							
Paper							
Mineral waste							
Septic waste							
Other:							

APPENDICE 1

3.2 Hazardous waste

Type of hazardous waste	Estimated quantity		Type of waste container	Emptying interval	Possibility to use on-site or locally (specify recycler and method)	Company of waste disposal	Method of disposal
	Vol (m ³)	Mass (t)					
Waste oil			in locked container in its own separate receptacle				
Paints and varnishes			own separate receptacles in locked container				
Solvents			own separate receptacles in locked container				
PCB-containing sealants			own separate receptacles in locked container				
Adhesives			own separate receptacles in locked container				
Batteries and accumulators			own separate receptacles in locked container				
Acids			own separate receptacles in locked container				
Transformers and capacitors containing PCBs			in locked container				
Other:							

3. WASTE COLLECTING AREA

HSE responsible person/Site Manager consulting with other Section supervisors decides suitable area for waste collecting at the construction site.

HSE responsible person takes a copy of the layout drawing of the site and draws by hand or with computer drawing program where is waste collecting area(s) at the site. There should be enough room for waste containers and waste handling. It is recommended that it would be in a place where waste is easily moved out from the site.

This map should be placed at the site's bulletin board/notice board where every employee can see it. This map should be saved as attach file with this Waste Management Plan – document in HSE folder of the project in IDM.

Filling the Waste Management Plan

1. PROJECT INFORMATION

In the first chapter there is asked general information of the project.

In “Project name and type” there should be written the official name and ID of the project and power plant type (oil, gas, dual-fuel, etc...).

2. WASTE MANAGEMENT COMPANY CONTACTS

In second chapter is asked information of the local waste management company that Wärtsilä is operating with. If project have many waste management companies to deal with, report all of them. So replicate this chapter as many times as you have different companies or give the information as attach file with this document.

In “Disposing method” fill is the waste management company’s disposing method: recycling/, landfill, incinerator or other combinations...etc.

To “Transport and containers” write if the waste management company is providing needed waste containers and transportation from the site or is it Wärtsilä’s site team responsibility.

To location “Possibility to receive hazardous material” mark if the company can receive hazardous waste. In many countries waste management companies have to have permission to hazardous waste handling.

3. WASTE MANAGEMENT INFORMATION

In chapter 3 is described different waste types collected at the site and the disposing methods of them. This chapter is divided to “Ordinary waste” and “Hazardous waste” tables.

In “Estimated quantity” you should fill estimation of how much each waste type is generated at the site. This estimation can be for example the quantity in one month or one week or what is reasonable. You have to mark the time unit clearly.

To “Type of waste container” you fill is the collecting place container, interchangeable platform, receptacle, original receptacle (recommended especially with hazardous wastes)...etc. Hazardous waste should never mix with other wastes. It is best if hazardous wastes are stored in the original receptacles because there is usually all the information of the waste marked in the receptacle. There can also be written some additional information: hazardous waste should be placed in a locked place, so it is written here.

APPENDICE 1

“Emptying interval” there you have to write how often you will empty your waste counters. Some waste types you have to empty once a week, some only once after construction work is finished. You have to take on account the type of the waste and also the size of the waste container.

To location “Possibility to recycle/reuse on-site or locally (specify recycler and method)” you have to mark if you can recycle the material at the site or if you can supply the waste somewhere where it is recycled or reused. Specify the recycler and the method of the recycling or reusing and also the amount of the waste that is recycled /reused.

In “Company of disposal” you write the waste management company that receives the waste. If all the waste is recycled /reused, you don’t have to mark anything here.

“Method of disposal”– if the waste is going to the waste management company, you should mark what is the method of disposal of the waste.

4. WASTE COLLECTING AREA

Here are instructions of making a map of the waste collecting area(s) of the power plant construction site. This map is part of this Waste Management Plan and it have to be placed in the bulletin board /notice board of the site.

Doc. Classification: **Internal**

Title:	Power Plants' Chemical List	DocID:	DBAB980243
		Revision:	4
Author:	HHA040 / Heidi Hakala	Sheets:	4
Draft by:	Hanna-Maija Honkanen 10/2011	Status:	Draft
Description:	Power Plants General Excel Sheet		

INSTRUCTIONS

This Wärtsilä Power Plants' chemical list **includes** chemicals that are used in construction of Wärtsilä power plant. It **does not include** chemicals that are used during operation of power plants (with certain exceptions). In addition it does not include chemicals that are supplied locally to the construction site of power plant. It includes only chemicals that come in Wärtsilä shipments.

Purpose of this list is to enhance chemical knowledge at construction site of power plants. Safe chemical handling and storing improves level of occupational safety at construction site. Information of the chemicals is now collected in one place where it is easier to find.

Chemical's **Material Safety Data Sheets** provide essential information about possible risks and hazards of chemicals. In addition there is shared practical information about chemicals handling and storing provided by producers of the chemicals. Material Safety Data Sheets of **all** the chemicals that are used in the construction site **should be available at site** offices.

Remember: Locally bought chemicals' MSDS should be also collected to the site.

This list **is not completely**. If you notice that some chemical is missing you can find instructions to apply it to the list from the **last sheet** of this document. If you have some other proposals for improvement concerning Wärtsilä Power Plant chemical management contact HSE Manager of Power Plant.

This sheet contains the instructions, next sheet is the chemical list and the last sheet contains hazard classification and pictograms according CLP Regulation. This new regulation implements the Globally Harmonised System (GHS) of Classification and Labelling of Chemicals into the European Union. At the same time old hazard symbols are replaced with new hazard pictograms. Transition period lasts until 2015.

APPENDICE 2

POWER PLANT'S CHEMICALS														
		Document ID										Power plant		
No:	CHEMICAL	Description	Producer / Importer	Publish year of Finnish MSDS	Publish year of English MSDS	Link to MSDS in IDM	Material number	Hazard symbol	Risk phrase	Safety phrase	Hazard statement	Precautionary statement	Construction	Commission
▼	Product name	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
1	3442 Casco Flex	Adhesive	Akzo Nobel Coatings Oy	2008	2008			—	—	\$2,29			X	
2	3880-00001 Casco Contact, vesiohenteinen	Waterborne contact adhesive	Akzo Nobel Coatings Oy	2003	2010			—	R52/53	\$2,29,60			X	
3	3914-00001 Casco Akustoseal	Acrylate copolymerbased sealent	Akzo Nobel Coatings Oy	2003	2004			—	—	\$2			X	
4	Activated carbon, Aktiivihili	Absorbent	Wärtsilä Sweden AB	2008	2008			—	—	—				X
5	CP 620	Firefoam	Hilti Ltd.	2003	2007			Xn	R20,36/37/38,42/43	\$2,23,24/25,36/37/39,45,51				X
6	Empire	Alkyd paint	Tikkurila Oyj	2008	2008			—	R10	\$2,23,46,51			X	

You can find this Power Plant's chemical -document from IDM with this ID address

Here is link to material safety data sheet of the chemical in Wärtsilä's internal document

Chemical products have material numbers for purchase operations

Hazard symbol, risk phrase and safety phrase are classifications that describes characteristics of chemical or mixture. These identifications are according old recessive classification

Hazard phrase (H-phrase) and Precautionary phrase (P-phrase) are new classifications of chemical danger characteristics

This section tells whether the chemical is used in construction phase or in commission phase of power plant

APPENDICE 2

POWER PLANTS' CHEMICALS		Document ID: DBAB980243							Hazard symbol	Risk phrase	Safety phrase	Hazard statement	Precautionary statement	Power plant	
No:	CHEMICAL Product name	Description	Producer / Importer	Publish year of English MSDS	Publish year of Finnish MSDS	Link to English MSDS in IDM	Link to Finnish MSDS	Material number						Construction	Commission
1	3442 Casco Flex	Adhesive	Akzo Nobel Coatings C	2008	2008	DBAB917434	DBAB920215		—	—	S2, 29			X	
2	3880-00001 Casco Contact, vesiohenteinen	Waterborne contact adh	Akzo Nobel Coatings C	2010	2003	DBAB917620	DBAB920219		—	R 52/53	S2, 29, 60			X	
3	3914-00001 Casco Akustose	Acrylate copolymerbase	Akzo Nobel Coatings C	2004	2003	DBAB920205	DBAB920232		—	—	S2			X	
4	Activated carbon, Aktiivihi	Absorbent	Wärtsilä Sweden AB	2008	2008	DBAB920192	DBAB920239		—	—	—				X
5	CP 620	Firefoam	Hilti Ltd.	2007	2003	DBAB920187	DBAB979180		Xn	R 20, 36/37/38, 42/43	S2, 23, 24/25, 36/37/39, 45,				X
6	Empire	Alkyd paint	Tikkurila Oyj	2008	2008	DBAB920184	DBAB920242		—	R 10	S2, 23, 46, 51			X	
7	esco PDV Salt	Salt	esco -european salt co	2004		DBAB920181			—	—	—			X	X
8	Fontecoat FL 100	Epoxy paint	Tikkurila Oyj	2010	2010	DBAB920177	DBAB920245		Xi, N	R 36/38, 43, 51/53	S23v, 24, 26, 29, 36/37/39, 51			X	
9	GHL 300-2950	Cast resin, used in cabl	ABB Ab	2010		DBAB920169			Xn	R 20, 36/37/38, 42/43	S23, 24, 26, 37, 45			X	
10	Hardener 008 4042	Hardener for Fontecoat	Tikkurila Oyj	2010	2010	DBAB920162	DBAB920253		Xi, N	R 36/38, 43, 51/53	S24, 26, 29, 36/37/39, 51			X	
11	LUJA pintamaali, puolihihmeä ja puolihiiltävä	Acrylate latex paint	Tikkurila Oyj	2008	2008	DBAB920158	DBAB920257		—	—	—			X	
12	Makroflex STD	Sealant	Henkel Makroflex Oy		2009		DBAB920260		F+, Xn, N	R 12, 20/22, 36/37/38, 40, 42/43,	S2, 23, 24/25, 29, 36/37/39, 45,			X	
13	Natriumhypokloriitti	Desinfectant and bleach	Algol Chemicals Oy		2007		DBAB920261		C	R 31, 34	S1/2, 28, 45, 50			X	
14	Natriummetabisulfiitti HP	Bleach	Algol Chemicals Oy		2011		DBAB920263		Xn	R 22-31-41	—	H302,H318, EUH031	P 280,P 301+P 312,P 330,P	X	
15	Nytro Libra	Insulating oil	Nynas AB	2010	-	DBAB920155	-		—	—	—	H304	—	X	X
16	P3-ultrasil 110	Cleaning product	Oy Ecolab Ab	2006	2010	DBAB979164	DBAB920273	PAAE125570	C	R 35	S2, 26, 36/37/39, 45				X
17	P3-ultrasil 75	Detergent	Oy Ecolab Ab	2009	2009	DBAB979174	DBAB920270	PAAE125571	C	R 35, R 8	S2, 26, 36/37/39, 45				X
18	Panssari Akva	Waterborne paint for me	Tikkurila Oyj	2009	2009	DBAB920151	DBAB920275		—	—	—			X	
19	Panssaripesu Cleaning det	An emulating detergent	Tikkurila Oyj	2008	2008	DBAB920148	DBAB920278		Xi	R 36	S2, 26, 37, 46, 51			X	
20	Sika Cleaner-205	Cleaner	Sika Limited	2008	2008	DBAB920143	DBAB920281		F, Xi	R 11, 36, 67	—			X	
21	Sika Mono Top-412 N	Repair plaster	Oy Sika Finland Ab		2009		DBAB920283		Xi	R 41, 37/38	S2, 26, 39, 46			X	
22	Sika Mono Top-910 N	Repair Plaster	Oy Sika Finland Ab	2010	2010	DBAB920136	DBAB920289		Xi	R 41, 37/38	S2, 26, 39, 46			X	
23	Sika Primer-210	Primer paint	Oy Sika Finland Ab	2010	2008	DBAB920133	DBAB920290		F, Xn	R 11, 36, 66, 67, 52/53	—			X	
24	Sika Primer-3 N	Primer paint	Oy Sika Finland Ab	2010	2009	DBAB920130	DBAB920291		F, Xi	R 11, 36, 66, 67	—			X	
25	Sikaflex Pro-3 WF	Polyurethane based sea	Oy Sika Finland Ab	2008	2010	DBAB920123	DBAB980033		—	—	—			X	
26	Sikafloor-2530 W Part A	Epoxy sealer coat	Oy Sika Finland Ab	2008	2008	DBAB920120	DBAB920296		Xi, N	R 36/38, 43, 51/53	S24, 37			X	
27	Sikagard 720 Epocem, Comp. A	Cement and epoxy seal	Sika I limited	2010	2008	DBAB920119	DBAB979446		Xi	R 41, 37/38	S2, 26, 39, 46			X	

HAZARD CLASSIFICATION AND PICTOGRAMS

ACCORDING EUROPEAN UNION CLP Regulation (the Regulation on the Classification, Labelling and Packaging of Substances and Mixtures)

Physical hazards



Explosive, E (exploding bomb)

Unstable explosives, Self reactive substances and mixtures, Organic peroxides



Oxidising, O (flame over circle)

Oxidising gases, Oxidising liquids, Oxidising solids



Gases under pressure (gas cylinder)

Compressed gases, Liquefied gases, Refrigerated liquefied gases, Dissolved gases



Extremely flammable F+, Highly flammable F (flame)

Flammable gases, Flammable aerosols, Flammable liquids, Flammable solids, Self-reactive substances and mixtures, Pyrophoric liquids, Pyrophoric solids, Self-heating substances and mixtures, Substances and liquids, which in contact with water emit flammable gases, Organic peroxides



Corrosive, C (corrosion)

Corrosive to metals

Health hazards



Harmful Xn, Irritant Xi (exclamation mark)

Acute toxicity (oral, dermal, inhalation), Skin irritation, Eye irritation, Skin sensitisation, Specific Target Organ Toxicity-Single exposure



Corrosive, C (corrosion)

Skin corrosion, Serious eye damage



Hazardous to health (health hazard)

Respiratory sensation, Germ cell mutagenicity, Carcinogenicity, Reproductive toxicity, Specific Target Organ Toxicity-Single exposure, Specific Target Organ Toxicity-Repeated exposure, Aspiration hazard



Very toxic T+, Toxic T (skull and crossbones)

Acute toxicity (oral, dermal, inhalation)

Environmental hazards



Dangerous for the environment, N (environment)

Hazardous to the aquatic environment

Hazard statements

Physical hazards

H200 Unstable explosive
 H201 Explosive; mass explosion hazard
 H202 Explosive; severe projection hazard
 H203 Explosive; fire, blast or projection hazard
 H204 Fire or projection hazard
 H205 May mass explode in fire
 H220 Extremely flammable gas
 H221 Flammable gas
 H222 Extremely flammable material
 H223 Flammable material
 H224 Extremely flammable liquid and vapour
 H225 Highly flammable liquid and vapour
 H226 Flammable liquid and vapour
 H227 Combustible liquid
 H228 Flammable solid
 H240 Heating may cause an explosion
 H241 Heating may cause a fire or explosion
 H242 Heating may cause a fire
 H250 Catches fire spontaneously if exposed to air
 H251 Self-heating; may catch fire
 H252 Self-heating in large quantities; may catch fire
 In contact with water releases flammable gases which may ignite spontaneously
 H260 In contact with water releases flammable gas
 H270 May cause or intensify fire; oxidizer
 H271 May cause fire or explosion; strong oxidizer
 H272 May intensify fire; oxidizer
 H280 Contains gas under pressure; may explode if heated
 H281 Contains refrigerated gas; may cause cryogenic burns or injury
 H290 May be corrosive to metals

Environmental hazards

H400 Very toxic to aquatic life
 H401 Toxic to aquatic life
 H402 Harmful to aquatic life

 H410 Very toxic to aquatic life with long lasting effects
 H411 Toxic to aquatic life with long lasting effects
 H412 Harmful to aquatic life with long lasting effects
 H413 May cause long lasting effects to aquatic life

Supplemental hazard information

Physical properties

EUH001 Explosive when dry
 EUH006 Explosive with or without contact with air

 EUH014 Reacts violently with water
 EUH018 In use may form flammable/explosive vapour-air mixture
 EUH019 May form explosive peroxides
 EUH044 Risk of explosion if heated under confinement

Health properties

EUH029 Contact with water liberates toxic gas
 EUH031 Contact with acids liberates toxic gas
 EUH032 Contact with acids liberates very toxic gas
 EUH066 Repeated exposure may cause skin dryness or cracking

 EUH070 Toxic by eye contact
 EUH071 Corrosive to the respiratory tract

Environmental properties

EUH059 Hazardous to the ozone layer

Health hazards

H300 Fatal if swallowed
 H301 Toxic if swallowed
 H302 Harmful if swallowed
 H303 May be harmful if swallowed
 H304 May be fatal if swallowed and enters airways
 H305 May be harmful if swallowed and enters airways
 H310 Fatal in contact with skin
 H311 Toxic in contact with skin
 H312 Harmful in contact with skin
 H313 May be harmful in contact with skin
 H314 Causes severe skin burns and eye damage
 H315 Causes skin irritation
 H316 Causes mild skin irritation
 H317 May cause allergic skin reaction
 H318 Causes serious eye damage
 H319 Causes serious eye irritation
 H320 Causes eye irritation
 H330 Fatal if inhaled
 H331 Toxic if inhaled
 H332 Harmful if inhaled
 H333 May be harmful if inhaled
 May cause allergy or asthma symptoms or breathing difficulties if inhaled
 H334 inhaled
 H335 May cause respiratory irritation
 H336 May cause drowsiness or dizziness
 H340 May cause genetic defects
 H341 Suspected of causing genetic defects
 H350 May cause cancer
 H351 Suspected of causing cancer
 H360 May damage fertility or the unborn child
 H361 Suspected of damaging fertility or the unborn child
 H362 May cause harm to breast-fed children
 H370 Causes damages to organs
 H371 May cause damage to organs
 H372 Causes damages to organs through prolonged or repeated exposure

 H373 May cause damage to organs through prolonged or repeated exposure

Supplemental label elements for certain mixtures

Contains lead. Should not be used on surfaces liable to be chewed or sucked by children.
 EUH201 sucked by children.
 EUH201A Warning! Contains lead
 Cyanoacrylate. Danger. Bonds skin and eyes in seconds. Keep out of the reach of children.
 EUH202 the reach of children.
 EUH203 Contains chromium(VI). May produce an allergic reaction.
 EUH204 Contains isocyanates. May produce an allergic reaction.
 EUH205 Contains epoxy constituents. May produce an allergic reaction.
 Warning! Do not use together with other products. May release dangerous gases (chlorine).
 EUH206 dangerous gases (chlorine).
 Warning! Contains cadmium. Dangerous fumes are formed during use. See information supplied by the manufacturer. Comply with the safety instructions.
 EUH207 instructions.
 Contains <name of sensitising substance>. May produce an allergic reaction.
 EUH208 reaction.
 EUH209 Can become highly flammable in use.
 EUH209A Can become flammable in use.
 EUH210 Safety data sheet available on request.
 To avoid risks to human health and the environment, comply with the instructions for use.
 EUH401 instructions for use.

APPENDICE 2

Precautionary statements:

General precautionary statements

- P101 If medical advice is needed, have product container or label at hand
- P102 Keep out of reach of children
- P103 Read label before use

Prevention precautionary statements

- P201 Obtain special instructions before use
 - Do not handle until all safety precautions have been read and
- P202 understood

- P210 Keep away from heat/sparks/open flames/hot surfaces – No smoking
- P211 Do not spray on an open flame or other ignition source
- P220 Keep/Store away from clothing/.../combustible materials
- P221 Take any precaution to avoid mixinn with combustibles
- P222 Do not allow contact with air
 - Keep away from any possible contact with water, because of violent
- P223 reaction and possible flash fire
- P230 Keep wetted with ...
- P231 Handle under inert gas
- P232 Protect from moisture
- P233 Keep container tightly closed
- P234 Keep only in original container
- P235 Keep cool
- P240 Ground/bond container and receiving equipment
- P241 Use explosion-proof electrical/ventilating/light/.../equipment
- P242 Use only non-sparking tools
- P243 Take precautionary measures against static discharge
- P244 Keep reduction valves free from grease and oil
- P250 Do not subject to grinding/shock/.../friction
- P251 Pressurized container – Do not pierce or burn, even after use
- P260 Do not breathe dust/fume/gas/mist/vapours/spray

- P261 Avoid breathing dust/fume/gas/mist/vapours/spray

- P262 Do not get in eyes, on skin, or on clothing
- P263 Avoid contact during pregnancy/while nursing
- P264 Wash ... thoroughly after handling
- P270 Do not eat, drink or smoke when using this product
- P271 Use only outdoors or in a well-ventilated area

- P272 Contaminated work clothing should not be allowed out of the workplace

- P273 Avoid release to the environment
 - Wear protective gloves/protective clothing/eye protection/face
- P280 protection
- P281 Use personal protective equipment as required
- P282 Wear cold insulating gloves/face shield/eye protection
- P283 Wear fire/flammable resistant/retardant clothing
- P284 Wear respiratory protection
- P285 In case of inadequate ventilation wear respiratory protection
- P231+232 Handle under inert gas. Protect from moisture
- P235+410 Keep cool. Protect from sunlight

Storage precautionary statements

- P401 Store ...
- P402 Store in a dry place
- P403 Store in a well ventilated place
- P404 Store in a closed container
- P405 Store locked up

- P406 Store in a corrosive resistant/... container with a resistant inner liner

- P407 Maintain air gap between stacks/pallets
- P410 Protect from sunlight
- P411 Store at temperatures not exceeding ... °C/... °F
- P412 Do not expose to temperatures exceeding 50 °C/122 °F
- P420 Store away from other materials

- P422 Store contents under ...

- P402+404 Store in a dry place. Store in a closed container

- P403+233 Store in a well ventilated place. Keep container tightly closed

- P403+235 Store in a well ventilated place. Keep cool

- P410+403 Protect from sunlight. Store in a well ventilated place
 - Protect from sunlight. Do not expose to temperatures exceeding 50
- P410+412 °C/122 °F
- P411+235 Store at temperatures not exceeding ... °C/... °F. Keep cool

Response precautionary statements

- P301 IF SWALLOWED:
- P302 IF ON SKIN:
- P303 IF ON SKIN (or hair):
- P304 IF INHALED:
- P305 IF IN EYES:
- P306 IF ON CLOTHING:

- P307 IF exposed:

- P308 IF exposed or concerned:
- P309 IF exposed or you feel unwell:
- P310 Immediately call a POISON CENTER or doctor/physician
- P311 Call a POISON CENTER or doctor/physician
- P312 Call a POISON CENTER or doctor/physician if you feel unwell

- P313 Get medical advice/attention
- P314 Get Medical advice/attention if you feel unwell
- P315 Get immediate medical advice/attention
- P320 Specific treatment is urgent (see ... on this label)
- P321 Specific treatment (see ... on this label)
- P322 Specific measures (see ... on this label)
- P330 Rinse mouth
- P331 Do NOT induce vomiting
- P332 If skin irritation occurs:
- P333 If skin irritation or a rash occurs:
- P334 Immerse in cool water/wrap in wet bandages
- P335 Brush off loose particles from skin
- P336 Thaw frosted parts with lukewarm water. Do not rub affected areas
- P337 If eye irritation persists:
- P338 Remove contact lenses if present and easy to do. continue rinsing
 - Remove victim to fresh air and keep at rest in a position comfortable for
- P340 breathing
 - If breathing is difficult, remove victim to fresh air and keep at rest in a
- P341 position comfortable for breathing
- P342 If experiencing respiratory symptoms:
- P350 Gently wash with soap and water
- P351 Rinse continuously with water for several minutes
- P352 Wash with soap and water

- P353 Rinse skin with water/shower
 - Rinse immediately contaminated clothing and skin with plenty of water
- P360 before removing clothes

- P361 Remove/Take off immediately all contaminated clothing
- P362 Take off contaminated clothing and wash before reuse
- P363 Wash contaminated clothing before reuse
- P370 In case of fire:
- P371 In case of major fire and large quantities:
- P372 Explosion risk in case of fire
- P373 DO NOT fight fire when fire reaches explosives
- P374 Fight fire with normal precautions from a reasonable distance
- P375 Fight fire remotely due to the risk of explosion
- P376 Stop leak if safe to do so

- P377 Leaking gas fire – do not extinguish unless leak can be stopped safely
- P378 Use ... for extinction
- P380 Evacuate area
- P381 Eliminate all ignition sources if safe to do so
- P391 Collect spillage
 - IF SWALLOWED: Immediately call a POISON CENTER or
- P301+310 doctor/physician
 - IF SWALLOWED: Call a POISON CENTER or doctor/physician if you
- P301+312 feel unwell
- P301+330+331 IF SWALLOWED: Rinse mouth. Do NOT induce vomiting
- P302+334 IF ON SKIN: Immerse in cool water/wrap in wet bandages
- P302+350 IF ON SKIN: Gently wash with soap and water
- P302+352 IF ON SKIN: Wash with soap and water
 - IF ON SKIN (or hair): Remove/Take off immediately all contaminated
- P303+361+353 clothing. Rinse skin with water/shower
 - IF INHALED: Call a POISON CENTER or doctor/physician if you feel
- P304+312 unwell
 - IF INHALED: Remove victim to fresh air and keep at rest in a position
- P304+340 comfortable for breathing
 - IF INHALED: If breathing is difficult, remove victim to fresh air and keep
- P304+341 at rest in a position comfortable for breathing
 - IF IN EYES: Rinse continuously with water for several minutes.
- P305+351+338 Remove contact lenses if present and easy to do – continue rinsing
 - IF ON CLOTHING: Rinse immediately contaminated clothing and skin
- P306+360 with plenty of water before removing clothes
- P307+311 IF exposed: Call a POISON CENTER or doctor/physician
- P308+313 IF exposed or concerned: Get medical advice/attention
 - IF exposed or you feel unwell: Call a POISON CENTER or
- P309+311 doctor/physician
- P332+313 If skin irritation occurs: Get medical advice/attention
- P333+313 If skin irritation or a rash occurs: Get medical advice/attention
 - Brush off loose particles from skin. Immerse in cool water/wrap in wet
- P335+334 bandages
- P337+313 Get medical advice/attention
- P342+311 Call a POISON CENTER or doctor/physician
- P370+376 In case of fire: Stop leak if safe to do so
- P370+378 In case of fire: Use ... for extinction
- P370+380 In case of fire: Evacuate area
 - In case of fire: Evacuate area. Fight fire remotely due to the risk of
- P370+380+375 explosion
 - In case of major fire and large quantities: Evacuate area. Fight fire
- P371+380+375 remotely due to the risk of explosion

HOW TO ADD NEW CHEMICALS TO THE POWER PLANTS' CHEMICAL LIST

Missing some chemical product?

This Power Plant's Chemical List is not completely. If you notice that there is missing some chemical which is used in the construction site of power plant we would appreciate if your help us to supplement this chemical list. This concerns only chemicals are delivered in Wärtsilä shipments.

You can send the requisite information of the chemical to Power Plants' HSE Officer Heidi Hakala (or HSE Manager). This information is needed of the new chemical:

- Material Safety Data Sheet
- Short description of the purpose of use

In addition if you notice that in this list is an old Material Data Sheet of some chemical, please let us know. Producers update their MSDS's at different intervals so it is sometimes difficult to keep up with them.

You can contact HSE Officer Heidi Hakala via E-mail from [here](#).