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Education and Training Needs for Effective Environmental Protection in Port Terminals

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Abstract. To prevent or reduce maritime pollution it is necessary to educate all personnel handling goods potentially dangerous for the environment. The paper analyses the current situation in the Port of Koper as a representative multipurpose port handling dangerous goods. Hazardous goods are discussed, along with means of prevention of environmental damage, primarily involving training according to STCW convention for crews, but also for the ports, which lack unified standards. UL FMT as well as other institutions within the project can prepare and then provide tailor-made training for port personnel. These courses would be in the management, operational and support levels - including awareness, preparedness, and first responses. Educational institutions must have highly qualified instructors and the project B4S will elevate skills. This article is limited strictly to the cargo transfer at terminals.

Keywords: maritime education, training course proposal, handling dangerous goods, IMDG Code, Marpol, port workers, first responders,

1. Marine Pollutants

Marine pollutants are substances which are subject to the provisions of MARPOL 73/78, as amended and related codes. These are the IMDG Code for packed cargoes, the IBC Code for bulk chemicals, the IGC Code for liquefied gases and the IMSBC Code for solid bulk cargoes. There is no special code for the transportation of oils. The GESAMP Composite List currently contains over 1000 hazard profiles. (GESAMP 2019).

All environmentally hazardous cargoes should be transported under provisions. The dangers are many: biodegradation, bioaccumulation, acute and chronic aquatic toxicity, human health issues and injuries from ingestion, skin contact, inhalation, consequences from acute and chronic toxicity, skin/eye irritation, seafood safety and/or interference with coastal amenities, degradation of coasts and coastal waters, oil slicks, etc. Particular dangerous substances are defined in the MARPOL convention and relevant Codes.

The convention and codes also provide recommendations regarding prevention of eventual environmental pollution and procedures in case of spillage to reduce the consequences.

2. Port of Koper and terminals handling dangerous good

The Port of Koper is the multi-purpose Slovenian port. It has twelve specialized terminals organized according to the goods or cargo they receive. Terminals handling environmentally dangerous goods are:

- Container terminal (CT) handling IMDG cargos

The CT is one of the larger container terminals in the Adriatic Sea, handling almost 1 mil. TEU in 2019. Among them are many containers filled with dangerous goods. There is no published statistic about the number of such containers. According to the authors' estimation, 3% of containers carry dangerous goods, around 30,000 TEU. Our estimation is that around 20% of them are Maritime pollutants which would amount to about 6,000 per year.

- Dry bulk terminal handling IMSBC cargos

The terminal handles minerals, industrial minerals and other bulk cargo. In general, there are not so many environmental hazards as other types of cargo. The main environmental problem in the port of Koper is dust arising during cargo operations. There are several million tons handled at this terminal each year.

- Liquid cargo terminal handling IBC cargos and oils

The liquid cargo terminal is where different oil products are handled as well as some chemicals (alcohols, phosphoric acid, styrene…) and vegetable oils. Most cargoes are of environmental danger. The handled quantity is more than one million tonnes per year

- Petrol terminal handling oil products

The petrol terminal is privately owned, within the Koper port, where tankers discharging oil products. Yearly this terminal transfers more than 2 mil. tons of oil products.

3. Cargo in packaged form (MARPOL III and IMDG Code)

Not all IMDG cargo in containers are marine pollutants. For the purpose of the IMDG code term Marine pollutants refers to substances with potential for bioaccumulation in seafood or because of their high toxicity threatening aquatic life. Packages containing a harmful substance are labelled to indicate that the substance is a marine pollutant.

Figure 1. Marine pollutant mark (*Source: IMDG Code*)

In the case of spillage, there is no large quantity of leaked substance, so the port workers must try to stop the leak before it reaches the water. The use of inert absorbent material, is appropriate for all such cargoes. The first reaction in the case of spillage must be in accordance with the Emergency Schedule (EmS) (IMO 2018a). Emergency schedules for spillage are marked with S. There are 26 different schedules, from S-A to S-Z. Cargoes posing a danger to environment could be water soluble or not. For both it is necessary to follow the schedule.

According to the IMDG code Chapter 1.3 (IMO, 2018) training is recommended (not compulsory) for all shore-side personnel involved in handling or documentation of dangerous goods. Shore personnel must attend the relevant courses provided by competent providers.

Shore personnel engaged in the transport of dangerous goods are those who:

- classify dangerous goods and identify proper shipping names of dangerous goods;
- pack dangerous goods;
- mark, or label dangerous goods;
- load/unload Cargo Transport Units;
- prepare transport documents for dangerous goods;
- offer dangerous goods for transport;
- accept dangerous goods for transport;
- handle dangerous goods in transport;
- prepare dangerous goods loading/stowage plans;
- load/unload dangerous goods into/from ships;
- carry dangerous goods in transport;
- enforce or survey or inspect for compliance with applicable rules and regulations; or
- are otherwise involved in the transport of dangerous goods as determined by a competent authority

The subject matter required by each level of training is detailed in section 1.3.1.2.1, for general awareness training, and in section 1.3.1.5 for function-specific training. In section 1.3.1.6 we find the table of the sections of the IMDG Code or other relevant instruments to be included in the function-specific training for the transport of dangerous goods. For the terminal personnel most relevant is function 10; but also workers who load/unload cargo transport units (function 4) and handle dangerous goods in transport (function 8) should have appropriate training.

Table 1. Sections of the IMDG Code or other relevant instruments to be included in the function-specific training for the transport of dangerous goods.

Function		IMDG Code part/section																	SOLAS chapter II-2/19	Port byelaws	National transport regulations	CSC	CTU Code	Emergency response procedures	First aid measures	Safe handling procedures
		1	2	2.0	3	4	5	6	6*	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9								
1	Classify	X	X		X		X											X								
2	Pack	X		X	X	X	X	X			X	X						X						X	X	X
3	Mark, label, placard			X	X		X																			
4	Load/unload cargo transport units	X		X	X	X	X		X		X	X										X	X	X	X	X
5	Prepare transport documents	X		X	X		X											X						X	X	
6	Offer for transport	X	X		X	X	X	X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
7	Accept for transport	X	X		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
8	Handle in transport	X		X	X		X		X			X								X	X	X		X	X	X
9	Prepare loading/stowage plans	X		X	X	X	X			X	X	X	X	X	X	X	X	X	X	X				X		
10	Load/unload from ships	X	X		X		X					X			X			X		X		X	X	X	X	X
11	Carry	X		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Source: IMDG Code (IMO, 2018)

Terminal workers under function 10 must receive special training related (but not limited) to knowledge about:

- Classes and their hazards,
- Marking, labelling and placarding
- Emergency response procedures

- First aid measures
- Safe handling procedures such as:
    - use of equipment
    - appropriate tools
    - safe working loads
- Cargo securing requirements
- CSC requirements,
- Local requirements at loading, transit and discharge ports
- Port byelaws; in particular, quantity limitation complying with national transport regulations

The Slovenian government after 11 years still had not complied with the applicable and mandatory national rules. Normally a national regulator appoints qualified institutions that provide recommended training. In Slovenia this training is done by 3 surveying companies, who are according to the order on designating the authorized companies to survey loaded dangerous goods and to issue certificates (Off. Gaz. RS, No. 50/95) authorized to survey dangerous good to be loaded on board.

They provide such training mostly for their customers mentioned under functions 3-9 (see above table). Currently the Port of Koper demands no such training. In the case of demand, the University of Ljubljana, Faculty of Maritime Studies and Transport has the qualified staff fulfill this mission. The faculty already provides training for seafarers according to the STCW convention.

4. Liquid bulk chemicals (MARPOL II and IBC Code)

Liquid bulk chemicals are the potentially most dangerous element for the marine environment. In particular the separation of the ship-shore connection with a delay in emergency response can cause great damage. The proper handling of such cargoes is covered by regulations in SOLAS Chapter VII - Carriage of dangerous goods and MARPOL Annex II - Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk. Both Conventions require chemical tankers to comply with the International Bulk Chemical Code (IBC Code), which established the international standards for the safe carriage in bulk by sea of dangerous chemicals and noxious liquid substances (IMO, 2021)

Chemicals are classified according to the IBC Code into four environmentally hazardous categories (IMO):

- **Category X:** Noxious Liquid Substances which are deemed to present a major hazard to either marine resources or human health;
- **Category Y:** Noxious Liquid Substances which are deemed to present a hazard to either marine resources or human health or cause harm to amenities or other legitimate uses of the sea;
- **Category Z:** Noxious Liquid Substances are deemed to present a minor hazard to either marine resources or human health and therefore justify less stringent restrictions; and
- **Other Substances:** substances which have been evaluated and found to fall outside Category X, Y or Z because they are considered to present no harm to marine resources, human health, amenities or other legitimate uses of the sea.

In the case of spillage, the crew as well as stevedores much react in accordance with material safety data sheet recommendations which are specific for each cargo. Usually such instructions are posted in an easily accessed well-known place (usually the cargo control room on board and at the terminal).

On the tankers, according to IBC Code regulation 16.3, all ship personnel should be trained in the use of protective equipment and have basic training in the procedures appropriate to their duties, necessary under emergency conditions. Personnel involved in cargo operations should be trained in handling procedures. Officers should be trained in emergency procedures to deal with conditions of

leakage, spillage, or fire involving the cargo based on guidelines and a sufficient number of them should be instructed and trained in essential first aid specific to the cargoes carried.

There are no mandatory or recommended regulations for shore side personnel training. The faculty is already providing expert training according to the STCW Convention for seafarers (IMO 2014a, IMO 2016)), which could applied as well to port personnel, but there is no demand from the Port of Koper. We believe that this is a gap in the environmental protection system in the port, which could be easy resolved.

5. Oils

In the Port of Koper independently operated two terminals transfer oils. (Additionally, bout 97% of vessels visiting the port have engines that run on oil.) The oil cargo operations are high risk and all necessary safety measures should be at the highest possible level, which includes well-trained port side personnel.

The safety recommendations for the safe carriage and handling of petroleum cargo including appropriate training for the ship's crew and shore personnel are prescribed in the ISGOTT, International Safety Guide for Oil Tankers and Terminals (OCIMF 2020). The recommended training for the terminal operators is prescribed in ISGOTT Ch. 15.1 Marine Terminal Operator Competence and Training. The type of training for the emergency situation is recommended in Chapter 20.6 Training for Emergencies and Emergency Exercises. Petrol (the private company) workers have basic training for oil and chemical tanker cargo operations in accordance with Model course 1.01 (IMO 2014a), while Port of Koper workers have only internal training

In case of emergency shut-down there is an emergency shut down button on jetty. The shore emergency shut down signal consists of a horn and red light. Upon activation of this button, jetty personnel should immediately be alerted to take proper measures. If an emergency occurs at the terminal requiring pumping stoppage to/from the vessel, this is immediately communicated to the dispatcher who informs the vessel and jetty personnel.

Another type of oil transfer is bunkering. Several ships that visit the port receive the fuel necessary for their next voyage. In the Port of Koper fuel is received by bunker barges from Trieste. This operation also requires all prevention measures to avoid spillage. Such transfers are carried out the ship's and barge's crews, but in case of spillage port emergency teams are engaged.

6. Emergency teams

In case of a pollution incident terminal workers or a ship's crew must call the security center of the port of Koper, where the situation is analysed and activates the applicable teams (firefighters or the marine safety and environmental protection department squad). In the case of larger pollution incidents, the center could engage outer sources like the City of Koper fire brigade, the Environmental Protection of Coastal Sea division (SVOM) or in case of even worse pollution, civil protection teams.

The Maritime Protection Service was established in 2006 to perform services related to the prevention and elimination of the consequences of sea pollution in the port area. This team covers all the duties related to sea protection and will take all the necessary measures in case of accidents. The team has all the necessary equipment to respond to minor incidents of pollution.

For the interventions in relation to the pollution at the terminal, the team of Port of Koper Fire Brigade is designated, as they are equipped and trained for such situations.

Regarding the oil spill, all team members (except newcomers) have passed appropriate training recommended by the International Convention on Oil Pollution Preparedness, Response and Cooperation, 1990 (OPRC) (IMO 1990) in the field of oil pollution preparedness and response. In this regard, four model training courses were developed aimed at the following:

- **LEVEL 0:** Introduction
- **LEVEL 1:** First Responders
- **LEVEL 2:** Supervisors and On-Scene Commanders
- **LEVEL 3:** Administrators and Senior Managers

Well trained, according to their function, and equipped, they can manage all kinds of minor or medium size pollution related emergency situations.

7. Education and training of port workers

To have ideally trained port workers at all terminals and/or prepared to act as part of emergency squads lengthy training is required. The table below presents the ideal course. The content is divided into three parts: A) wherein the content is only for the acquisition of the facts; B) wherein technical details are important; and C) dedicated for practical training and exercises. The + sign means from 0 to more than 100. This depends on the tactical needs of course participants.

Of course, for the port workers, their priority is their daily job. Our recommendations, though, are created based on the current commercial maritime circumstances, which unfortunately include a great many threats to lives and the environment in general.

Table 1. Ideal training course proposal template

ITEM	A	B	C
STAKEHOLDERS (IMO, Flags, Ports, Shipping Companies, Ships…	2	10	0
MARPOL I General	1	0	0
MARPOL I Cargo	1	3	3
MARPOL I Fuel	1	2	2
MARPOL II General	1	0	0
MARPOL II Bulk Chemicals	1	10	5
MARPOL II Liquefied gases	1	5	3
MARPOL III IMDG pollution prevention/EmS	1	8	3
MARPOL IV Sewage	1	3	3
MARPOL V Garbage collection/separations	1	5	2
MARPOL V Garbage handling/delivery	0,5	2	1
MARPOL V Garbage on board treatment	0,5	2	1
MARPOL VI Exhaust gases	1	4	3
IMSBC	1	3	1
ACCIDENTAL POLLUTION General	1	0	0
Small oil spill (SOPEP)	1	3	3
Large oil spill (IMO Level 0,I, II, III)	1	+	+
Chemical spill	0,5	+	+
Gas leakage	0,5	+	+
OTHER SOURCES OF POLUTIONS General	1	0	0
BALLAST	1	10	5
ANTIFOULING	1	3	3
NOISE	1	5	3
DRY CARGO RESIDUES	1	3	1
SHIP RECYCLING	1	5	3
SEA BED DAMMAGE during maneuver, dredging, anchorage, grounding …)	0,5	3	1
OTHER ITEMS RELATED TO ENVIRONMENTAL ISSUES General	1	0	0
Energy efficiency	1	3	1
ISM/SMS requirements	1	10	5
PORT PROCEDURES	1	3	3
INSPECTIONS (FSC,PSC, CLASS..)	1	5	3
LARGE PASSANGER SHIP SPECIAL PROCEDURES	0,5	5	3
ADMINISTRATION (RECORD BOOKS…)	1	5	10
TRAINING REQIREMENTS (review of existing requirements like, STCW, IMO LEVELS, IMDG, IMSBC…	1	3	0
TOTAL	32	123+	71+

The training is for 3 levels – management, operational, and support. And even in this case, a course should cover basic matters, ideally including a course on the properties of each and every hazardous material personnel may encounter (awareness); preparation for regular work (preventive); and extended for those who will be in the front line in the case of pollution emergency.

The basic level for managers must include knowledge about international and national rules, normal working processes and emergency procedures. This course is recommended for top

management (Supervisory Board and the Management Board members, public relations, etc.). Only the content of column A is required.

Those who supervise operations in the particular terminal (terminal managers, commanders of emergency squads…) must receive more knowledge about particular problems related to cargo transfer at the terminal. Such a course is important to prepare efficient prevention plans and preparation for emergency situations. The non-relevant topics may be cut, while recommended hours depends on the handled cargo.

On the operational level we suggest only one type of course that combines awareness, prevention, and emergency joined together. The personnel who lead daily operations (stevedores, foremen, etc.) must know all details about the potential sources of pollution and every possibility in regard to an accident or incident, including the first reaction in such cases, and the organization of work necessary to prevent any type of accident.

Support level course are dedicated to ordinary workers, who are working in accordance with instructions received by operational level superiors. Here we suggest courses at two levels. The first is basic, in which it is important to raise awareness regarding the handling of environmentally dangerous goods. The second type of course should be dedicated to personnel working with special equipment (crane operators, pump men, etc.) whose mistakes can cause pollution, and for those personnel engaged in the emergency squad.

8. Conclusion

The appropriate training of all port workers, including management, is essential to prevent eventual environmental damage. There are many international recommendations and guidelines in regard to training such personnel. In this paper authors we provide suggestions for the organise such training in ports in general as well as for particular terminals, where environmental damage can arise., as well as indicating the lack of proper training currently.

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