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Hazard Identification and Risk Analysis for shipping on Marine Environment: X-Press Pearl Incident

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Abstract: The X-Press Pearl incident can be considered as the worst maritime disaster to have struck in the history of Sri Lanka. It had a significant impact on Sri Lanka's sensitive costal environment, local communities and the economy. The extent of the disaster caught the attention of international bodies including the United Nations (UN). This paper focuses on identifying hazards and risks caused by the X-Press Pearl incident and the steps that should be taken to minimize the impact on marine and social bodies.

Index Terms: Chemicals, Disaster, Hazard, Impact, Marine Life, Plastic Palettes, Pollution, Risk Analysis United Nations

1 INTRODUCTION

On 20th May 2021, an emission of chemical fumes erupted on Singapore flagged MV X-Press Pearl containership which was anchored 18km to the northwest of Colombo [1]. Around five days later on 25th May a fire broke out with a limited explosion throwing overboard an unknown number of containers which contained dangerous chemicals and pellets of plastic [1]. Around a week later on 2nd June the process of towing the vessel was initiated which ended up in a disaster resulting an oil spill on an area of 0.5km around the disaster zone [1]. Luckily the ship crew was safely evacuated and no human casualties were reported from the incident. However, this incident can be considered a disaster which left a red flag on Sri Lankan government due to poor hazard identification and risk assessment committed by the responsible authorities.

2 IMPACT ON ENVIRONMENT AND LOCAL COMMUNITIES

On 17th of June following the incident a United Nations team mission was launched to assess the incident [2]. The primary goal of the team was to obtain an overview of the situation and to report back the findings to the board of directors. Under the researched conducted, the UN team submitted a series of observations grouped under following focus areas.

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2.1 OIL POLLUTION

Following the disaster, on 2nd June, an oil slick which was 0.5km in area and 3.23km in length was detected through satellite imagery which is given in Fig. 1. However, a visible extension of the spill was observed on 14th June, which was estimated up to 4.3km in length [3].

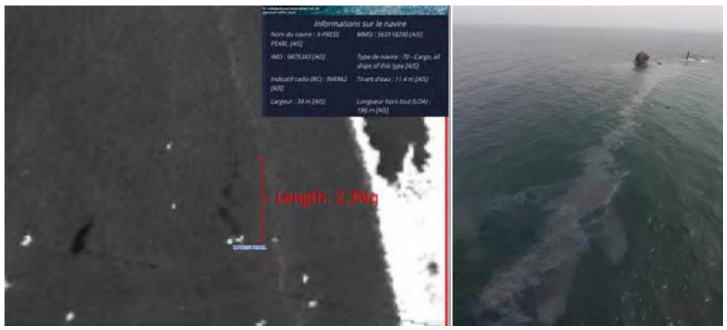

Fig. 1. Satellite and observation imagery of originated oil slick

Based on further investigation it was determined that the released oil spill was composed of Bunker Oil (IFO 380). Bunker Oil is a type of oil obtained by mixing 95% of HFO with 5% gasoline [4]. Considering the nature of oil and environmental conditions like water currents it was pre forecasted that the oil will most probably resurface and spread as tar balls on the seashore.

2.2 CHEMICAL POLLUTION

Out of 1486 containers carried by the vessel 81 containers were found to be carrying hazardous substances according to the International Maritime Dangerous Goods code (IMDG Code). Fig. 2 shows the detail list of the vessel manifest.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Bay	Operator	POL	POD	Final destination	Serial	STATUS (EMPTY/ LADEN)	I	R	SizeType	Pos.	W	Type	Spec.	IMDG	UN	CARGO DETAILS
7	9	RSL	AEJE1	LKCMB	LKCMB	BLKU2604634		x		20TK	90182	23,3	2270	I	3	1301	Vinyl Acetate, stablised
8	9	MSK	QAHMD	LKCMB		TEMU1537704				20ST	90184	19,2	22G1				Epoxy Resin, plastic
14	9	MSK	QAHMD	LKCMB		MSKU5030739				20ST	90382	19,3	22G1				Epoxy Resin, plastic
20	9	GENIO	AEJE1	SGSIN	MYPKG	PCIU2585635				20ST	90582	15,2	22G1				FOOD PRODUCTS
21	9	BLPL	AEJE1	SGSIN	MMRGN	TRHU1928620				20ST	90584	4,4	22G1				RECONDITIONED -WAGON (LEFT HAND DRIVE)
22	9	BLPL	AEJE1	SGSIN	IDJKT	BSIU2108497				20ST	90586	5,6	2200				FIRE PUMP (BRAND NEW FIRE PUMPSET WITH COMPLETE ACCESSORIES)
23	9	BLPL	AEJE1	SGSIN	BDCGP	BLZU2105581				20ST	90588	3	2200				NEW ELECTRIC DRIVEN FIRE PUMP
24	9	ACAP	AEJE1	LKCMB	LKCMB	CRSU1059592				20ST	90590	2,4	2210				2600 CARTONS + 1700 PAILS OF LUBRICATING OIL OF CASTROL BRAND
34	10	MSK	QAHMD	LKCMB		MSKU6597780				40ST	1E+05	29,7	42G1				Epoxy Resin, plastic
35	10	MSK	QAHMD	MYTPP		MRKU5224434	E			40HC	1E+05	3,7	45G1	H			EMPTY
37	10	MSC	QAHMD	LKCMB	BDCGP	MSCU5745728				40ST	1E+05	29,9	42G1				1020 BAG(S) of HIGH DENSITY POLYETHYLENE (HDPE)
38	10	MSK	QAHMD	LKCMB		MRKU0170891				40ST	1E+05	29,6	42G1				Epoxy Resin, plastic
39	10	MSK	QAHMD	MYTPP		MRKU3306132	E			40HC	1E+05	3,7	45G1	H			EMPTY
43	10	EVG	AEJE1	MYTPP	MYPKG	GAOU6303031	E			40HC	1E+05	4	45G1	H			EMPTY
44	10	EVG	AEJE1	MYTPP	MYPKG	EGHU9190706	E			40HC	1E+05	4	45G1	H			EMPTY
45	10	EVG	AEJE1	MYTPP	MYPKG	EGHU8216880	E			40HC	1E+05	4	45G1	H			EMPTY

Fig. 2. Excerpt of the vessel manifest

By accessing the chemical compositions and the short-term behavior of compounds special attention was paved into 25 tons of Nitric Acid and 1040 tons of Caustic Soda released into the sea through damaged

containers [5]. High corrosive properties of these substances and inclination towards dissolvement would have a higher impact on marine life of the disaster area. This explains the bleached carcasses of dead turtles found on the sea shore.

2.3 RISKS ARISING FROM THE SHIP WRECK

The disaster wreck which was not fully submerged proposed a threat to the navigation of vessels approaching Colombo harbor. High probability of lost containers and the sea currents carrying them into unknown locations increased the risk of collisions with merchant ships travelling the area. Sri Lankan authorities had to take steps to impose travel restrictions around the areas of shipping wreck and submerged containers until a clearance of the total wreckage was concluded.

2.4 PLASTIC POLLUTION

The plastic pollution can be considered as one of the major environmental impacts caused by the disaster incident. Plastic palettes released into the sea were identified as Linear Low-density Polyethylene (LLP) from sizes 1mm-5mm and higher than 5mm which were considered as macro particles [6]. Debris of plastic had been washed over a stretch of 300km alone the western cost of Sri Lanka. These drifted plastic palettes were mixed up with sand and the small size of them caused the recovery process much harder than usual (Fig. 3).

Fig. 3. Massive arrival of plastic pollution on the west coast of Sri Lanka following the incident

Massive cleanup sessions were implemented by the Sri Lankan Armed forces accompanied by locals prioritizing the impact of contamination. Approximately 1,610 metric tons of plastic which is an equivalent of 53,677 bags were recovered through these operations [1].

2.5 IMPACT ON SENSITIVE ENVIRONMENTS AND FISHERY

The X-Press Pearl incident had a significant impact in Sri Lankan marine life. Incident occurring in shallow waters influenced heavily on Sri Lankan coral reefs and breeding grounds of rare fish like Spiny Lobsters, Crabs and Marine aquarium fish. Plastic palettes were also observed floating in mangroves around Negombo area. According to the department of Wildlife Conservation 251 cases of dead Turtles were reported as of 17th July. Additionally, 33 marine mammals, 28 Dolphins and 5 Whales were washed ashore following the incident [1]. It is also noteworthy that emitted biotoxins had bleached and burnt off shells of turtles which was a reason for the higher mortality rate of the marine life (Fig. 4).

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Fig. 4. Turtle with bleached shell suggesting potential burn

Consequently, costal fishing along a stretch of 80km along the incident was banned by the authorities. Sri Lankan fishing communities whose livelihood were solely dependent on fishing, stroke a heavy impact as a result of this. There were also reported incidents on fishing gear being damaged due to the entanglement of plastic debris on fishing equipment (Fig. 5).

Fig. 5. Nets entangled with synthetic fibers

Furthermore, public health concerns were raised due to the chemical contamination and fish accidently feeding on small sized plastic palettes. According to an analysis conducted by National Aquatic Resource Agency (NARA) fish with plastic pallets lodged around gills were to be found confirming suspicions (Fig. 6).

Fig. 6. Fishes with plastic palettes in pharynx

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2.6 AIR POLLUTION

The erupted fires lasting for around 10 days without proper exhaustion caused significant air pollution. Smoke fumes rose from the fire extended up to several kilometers spreading pollutants around the surrounding area. Considering the goods carried by the cargo it can be considered that the smoke itself had contained a toxic mix of pollutants including Nitrogen Oxides, Sulphur Dioxide, Carbon Monoxide, soot and heavy metals [1]. A heavy deposition of fire residue was also to be observed on sea and land. The extent of atmospheric pollution can be considered an understated argument that occurred following the incident.

3 HAZARD IDENTIFICATION AND RISK ANALYSIS

Considering the identified hazards and associated risks, recommendations to minimize the impact zone can be provided fewer than four focus areas in order to avoid future destresses.

3.1 MITIGATING AND ELIMINATING RISKS

3.1.1 OIL SPILL SURVEILLANCE AND RECOVERY

The spill of oil into the ocean should be represented as a growing threat where real-time actions should be taken to minimize its severity. Initially steps must be taken to stop the oil leakage as soon as possible by closer inspection of the leakage. Restricting the oil belt can be achieved by implementing Oil Boomers around the disaster zone. Daily monitoring of the oil discharge through helicopters and boats is also important. Analyzing the oil slick through satellite imagery and modeling the oil spread trajectory can also be done considering drift directions to predict future plans and precautions.

3.1.2 CHEMICAL POLLUTION RECOVERY

Development of a well-coordinated plan is needed for a swift recovery from the transpired chemical pollution. As the initial step data on the materials transported by the shipping containers should be gathered by contacting relevant parties. Accordingly, bio monitoring programs can be initiated. Using Bivalves for water quality detection can be a simple and cost-efficient method. Furthermore, checking water quality parameters like pH value and Oxygen concentration should be regularly conducted.

3.1.3 REMOVAL AND DECOMMISSIONING OF SHIPWRECK CONTAINERS

The disaster zone being close proximity to Colombo harbor, shipwreck had a direct threat to the navigation of other vessels in the area. Necessary actions should be taken for the removal of entire wreck after the recovery of remaining Bunker fuel. In addition, the lost containers being submerged and remerging on random locations posed a risk for local fisherman boats. Therefore, immediate actions should be taken to locate lost containers and debris using technologies like Sonars and recovering them back to the shore.

3.2 PLASTIC POLLUTION CLEAN-UP

X-Press Pearl incident can be considered the single largest plastic spill in the history of Sri Lanka. Following steps can be taken to access the cleaning process of the plastic debris in a systematic manner.

- Chemical analyses of released plastic components and categorizing them as hazardous or nonhazardous wastes

- If found hazardous appropriate disposing methods should be facilitated while reuse and recycling methods should be facilitated if found non-hazardous
- On site separation methods and small particle recovery processes should be conducted during shore cleaning operations.
- Handling and transportation of collected plastic bags should be properly maintained to avoid secondary pollution.

Furthermore, long-term beach clean-up programs can also be organized to make sure future residues won't be collected on costal shores.

3.3 ENVIRONMENTAL ASSESSMENT AND MONITORING

3.3.1 MARINE POLLUTION ASSESSMENT

An environmental assessment plan should be organized focusing on short-term and long-terms impact of the disaster. Under short-term assessment the area of wreck, lost containers and shores with high plastic debris should be closely monitored. Based on the findings of the short-term assessment the long-term plan should be designed. Long-term assessment focuses on environmental sensitive areas like mangroves, coral reefs and estuaries. Following assessments helps in remediating future maritime incidents.

3.3.2 FISHERIES ASSESSMENT

A Fisheries assessment should be conducted to clarify concerns over overall seafood safety. Factors such as chemical compositions of infected waters and sea salt microplastic contaminations should be monitored to determine the safety of seafood for human consumption. The status of the ban for fishing will also be depended on results of the fisheries assessment.

3.3.3 MARINE WILDLIFE ASSESSMENT

Following assessment is carried out to determine the causes of mass Turtle and marine animal mortalities. Toxicological analysis of specimens should be conducted to find the presences of chemicals and biotoxins of the infected. Surveys on sensitive ecosystems and underwater investigations should also be conducted under the supervision of Ecologists for risk assessment of the natural habitat around the disaster zone. These experiments are conducted by qualified medical and scientific experts.

3.3.4 AIR POLLUTION ASSESSMENT

Under the generation of large quantities of fumes and fire residues, an air pollution assessment should not be neglected. The chemicals burnt in the explosion and the fire residues remained close seashores should be analyzed in determining the severity of the pollution impact.

3.4 STRENGTHENING MARITIME DISASTER MANAGEMENT CAPACITY

Taking X-Press Pearl disaster into consideration a well specified maritime disaster management plan could be initiated to respond in future maritime accidents. Following steps could be taken in establishing a successful disaster recovery plan

- Reviewing of institutional arrangements
- Regular training sessions for maritime emergencies

- Costal environment monitoring programs
- Establishing emergency response alerts
- Incorporation with international partners such as South Asia Co-operative Environment Program (SACEP) and South Asia Seas Program (SASP)

Taking these steps can strengthen the institutional basis of Sri Lankan maritime management spectrum making them more prepared on future incidents.

4 CONCLUSION

As we can all agree upon MV X-Press Pearl incident had a significant impact on Sri Lanka's costal environment, local communities and economy. In addition to these, many complexities began to unfold due to the current situation of the world in the context of COVID-19 pandemic. The Sri Lankan government in relation with foreign bodies took a considerable effort in mitigating the impact of the disaster. However, through the post analysis of the incident many more factors and courses of action that should have been considered through the disaster timeline were discovered. By following gained expertise and newly addressed disaster recovery and management plans future incidents of this sort could be dealt with much ease.

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