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Research Results
Резултати от научни изследвания

THE RISK ANALYSIS OF CHEMICAL TANKERS PASSING THROUGH THE TURKISH STRAITS BETWEEN 2010 – 2022

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Abstract. This analysis aims to highlight the risk created by the chemical tankers by comparing their movements in the Turkish straits. This information is based on actual ship movements from south to north and the return voyage, showing the prominence of chemical tankers passing through the straits between 2010 and 2022 and underlining the importance of the Turkish Straits. Istanbul Bosporus transit passages are being regulated by the Montreux Convention[1], signed 84 years ago. As per the convention, international shipping provided safe and seaworthy ships, has the right of free passage through the Straits in peacetime. Since the convention has been in force, the volume and frequency of the ships have increased almost tenfold, an interesting correlation on average, there were13 passages in a day in 1938; which increased to 65 by1985 and 115 by 2019. The main reason for this increase is said to be the hydrocarbon reserves of the Caspian Region[2]. As the number of passages increased enormously, so did the physical risk to shipping and the environmental and biological risk to local species. In order to minimise any possible risks and provide safer and environmentally friendly traffic, Turkish authorities have had to adopt Maritime Traffic Regulations for the Turkish Straits on 15/08/2019 (VTS – Vessel Traffic System)[3].

Keywords: risk analysis; chemical tankers; Turkey

1. Introduction

The Turkish Straits are natural waterways with a total length of 164 nautical miles, where the Istanbul Strait is 17 Nm, the length of the Marmara Sea 110 Nm and the Canakkale strait 37 Nm. Because of the strategic location, the straits are vital for the global economy, particularly for the Black Sea countries. The famous Russian lawyer "Frederic de Martens"[4] pointed out the importance of the straits as follows (Turan 2004):

The Turkish Straits are one of the busiest and narrowest natural waterways in the world. They are located in a very strategic area that connects the Black Sea with

the Mediterranean Sea and ultimately with the Atlantic Ocean via the Straits of Gibraltar and in the other direction the Indian Ocean via the Suez Canal. Considering the oil production in Russia, Azerbaijan, Kazakhstan and Turkmenistan, and with increasing worldwide demand for oil, the western and eastern countries are more dependent on the straits, which in turn increases its strategic importance.

Due to the Meteorological and hydrographical factors of the Turkish Straits, the risks for the pollutions, collusions and accidents are challenging factors that affect unfavourably the navigation through the Straits. These factors, such as rapid turns[5], strong currents, and unpredictable weather changes, make the straits one of the world's most challenging natural waterways[6]. The different density between the Aegean and Black Seas creates a surface current that reduces the water flow on the ship's rudder and creates difficulties for the ship's navigation, restricting manoeuvrability.

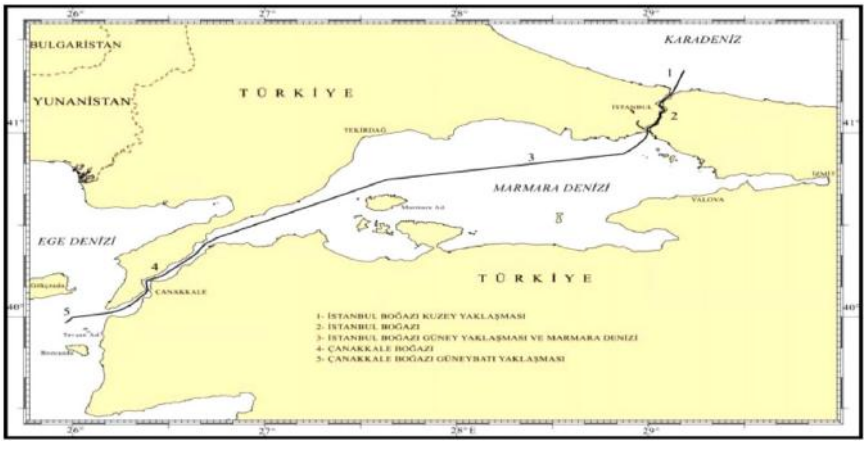

Figure 1. Turkish Straits

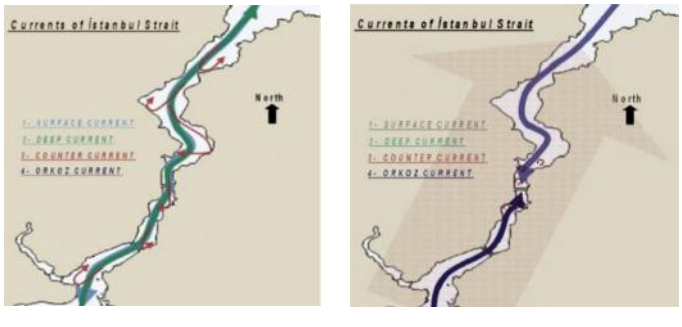

Figure 2. Currents of Turkish Straits[7]

Turkish Straits has even more importance in geostrategic and geo-economics features than other waterways used in the world such as Gibraltar, Denmark Straits, Kerch, Korea Hurmuz Straits and Otranto Straits.

2. Marine traffic risk at the straits

The Turkish Straits play a vital role in transporting oil from the Black Sea to other parts of the world. Around 22% of the Straits passages are performed by tankers moving oil and other liquid cargoes such as chemicals, vegetable oils and base oils. In 2019, 9500 tankers sailed through the Straits, of which 6056 were product tankers, 2729 were chemical tankers, and 615 were gas tankers. Most of the cargoes carried by tankers were 80% crude oil originates from Russia, Azerbaijan and Kazakhstan[8]. In addition to physical, hydrographical and meteorological restrictions on safe navigation, the sheer intensity of marine traffic through the Bosporus is yet another hazard; it is four times busier than the Panama Canal and three times busier than the Suez Canal.

Figure 3. Comparison of the Bosporus, Suez Canal and Panama Canal

This comparison clearly shows that the Istanbul Bosporus has many times more passages than the Panama and Suez Canals, which illustrates the level of marine traffic and the increased risk to which a ship would expose during transit of these canals/straits.

Chemical tankers are some of the most advanced vessels in terms of technology and safety and are also strictly regulated. However, because of human or mechanical error (sometimes due to the ship's complexities), they have always been prone to accidents. The case of MV Vita Spirit[9] in 2018, which damaged one of the local shoreside historical mansions, shows how risk is clear and present in the Straits. For avoiding any future accidents and-or casualties, the Turkish authorities took action and put into force new preventative measures. The new measures were in force as of 1 September 2019 and included several preventative clauses[10]. This type of accident

could happen to a chemical tanker carrying, for example, an explosive cargo, which in this instance would damage not only historical monuments but could potentially cause widespread infrastructure damage and loss of life for a large part of Istanbul; as a result, this vital shipping lane upon which the world relies could well end up being closed for an extended period of time. Therefore, due to the level of the risk associated with ships transiting the straits, measures need to be in place to minimise this aspect whilst allowing passage a fine balance, but of course, vital.

Evaluation of such risks (in this case, a chemical tanker's involvement in a hypothetical accident) is calculated by multiplying the probability (P_i) and consequences (C_i), and the contingency risk assessment as below (Korcak, Balas, Kurt & Turan 2015):

$$Risk = C_1P_1 + C_2P_2 + \cdots + C_nP_n \sum_{i=1}^{n} C_iP_i$$

Formula 1. Contingency risk assessment equation

In principle, marine accidents happen when two ships collide or ship grounds on coastal structures or features. In the case of one ship sailing in the Bosporus, the collision risk is "zero", and the grounding risk is 1. In the case of two ships in the Bosporus at the same time, the risk for collision is one and the risk for grounding two. In reality, in 2018, an average of 3425 ships in a month and 115 ships in a day have passed through. Although the number indicates the significant risk that the straits endure each day, chemical tankers actually have made up only 6% of those voyages. The Equation 1 above shows that a more significant risk is due to the number of older and badly-maintained ships. Thus, considering the decreasing average age of chemical tankers and their technological characteristics, the straits may be considered progressively safer with the passage off-time, inherent risk being minimised, and environmental pollution decreasing due to advancing technology in ships and their fuel.

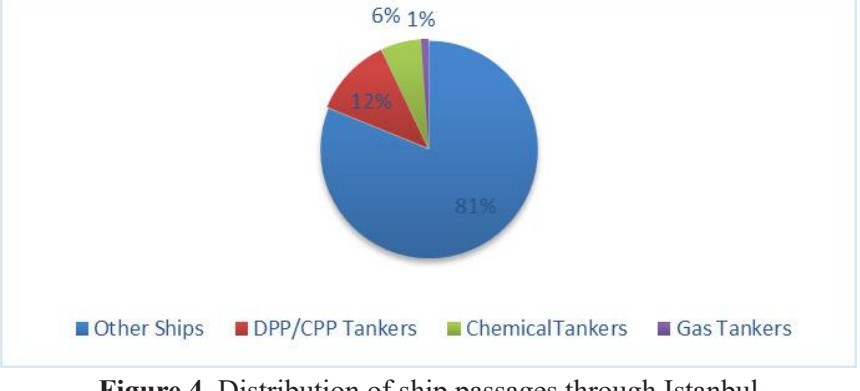

Figure 4. Distribution of ship passages through Istanbul
1 January – 30 June 2020

Figure 4 shows that the tanker markets (DPP/CPP, Chemical and Gas) overall represents 19% of all ship passages through the Bosporus in 2020 (January-June), of which 12% are DPP/CPP tankers, 6% chemical tankers and 1% gas tankers.

3. Turkish straits "LOG JAM"

For the last ten years, the number of passages through the straits reduced considerably. 20% of passing ships are tankers carrying dangerous cargoes. Since the global economic crisis, the number of ships passage has shown a marked decrease, but in juxtaposition to this trend, the percentage of transiting tankers increased.

Table 1. Distribution of all ship's passages from Istanbul Bosporus

Istanbul Straits			
Years	**Total Passages**	**Tanker Passages**	**%**
2010	50871	9274	18.230426
2011	49798	9103	18.279851
2012	48329	9028	18.680295
2013	46532	9006	19.354423
2014	45529	8745	19.207538
2015	43544	8633	19.825923
2016	42553	8703	20.452142
2017	42978	8832	20.550049
2018	41103	8587	20.891419
2019	41112	8957	21.786826
2020	38404	8435	21.963858
2021	38551	8248	21.395035
2022	35146	8653	24.620156

Table 1. shows that in 2010 the percentage of tankers was 18%, and in five years, it increased to 20% and in 2019 was almost 22%. Increasing tanker passages means an increase in the level of risk. Similar levels are observed in the Canakkale region, with the tankers' share similarly growing to 22%.

Table 2. Distribution of Tanker Passages from Istanbul Bosporus
In the figures, crude oil tankers are categorised within DPP/CPP

Total Istanbul Passages							
YEAR	**TTL**	**DPP/CPP**	**%**	**Chemicals**	**%**	**LPG/LNG**	**%**
2010	9274	6464	69.700237	1711	18.449429	1099	11.850334
2011	9103	6216	68.285181	1660	18.235746	1227	13.479073
2012	9028	5913	65.496234	1779	19.705361	1336	14.798405
2013	8934	5613	62.827401	1580	17.685247	1741	19.487352
2014	8843	5685	64.288138	1618	18.296958	1540	17.414904
2015	8633	5825	67.473648	1576	18.255531	1232	14.270821
2016	8703	6033	69.320924	1681	19.315179	989	11.363898
2017	8832	6212	70.335145	1878	21.263587	742	8.4012681
2018	8587	6014	70.036101	1950	22.708746	623	7.2551531
2019	8957	5934	66.24986	2462	27.486882	561	6.2632578
2020	8435	5252	62.264375	2653	31.452282	530	6.2833432
2021	8248	5085	61.651309	2701	32.747333	462	5.6013579
2022	8653	5447	62.949266	2782	32.150699	424	4.9000347

The above figures (Table 2) show the changes within the last ten years; while the petroleum products market decreased, the chemical market showed a considerable increase. In 2010 there were 6464 (69%) oil tanker passages. Within the same year, the chemical market contributed 1711 (18%) passages. In 2019 the numbers decreased to 5934 (66%) oil tanker passages, while the chemical tanker market boomed to 2462 (27%) passages.

4. Comparative analysis of the Turkish straits between 2019 and 2022 from January until June

The purpose of this article is to compare figures for marine traffic in the Turkish straits, based on actual ship movements from south to north and the return voyages. The statistics also show that for the first half of 2019 and 2022, Chemical Tankers are the least affected by COVID 19, while Cruise and Passenger ships are the most affected segment in shipping[11]. Moreover, the significant number of voyages overall indicates that international trade remains strong, even considering the debilitating effects of a global pandemic. It is interesting to note that chemical tanker passages in and out of the Bosporus straits over this period have shown an upward trend.

Table 3. Evolution in the number of passages from Turkish straits per year for different ship types (most adversely affected ship type indicated in red and least affected in green)

ISTANBUL BOSPORUS																	
Ship Types	January			February			March			April			May			June	
	2019	2020	Diff	2019	2020	Diff	2019	2020	Diff	2019	2020	Diff	2019	2020	Diff	2019	2020	Diff
Bulk Carrier	689	725	36	650	706	56	744	735	-9	635	776	141	645	673	28	590	531	-59
Containership	217	242	25	200	223	23	231	203	-28	234	208	-26	219	236	17	225	193	-32
General Cargo	1519	1521	2	1301	1369	68	1616	1333	-283	1587	1571	-16	1600	1413	-187	1519	1243	-276
Livestock Carrier	34	36	2	33	30	-3	39	47	8	48	49	1	52	56	4	50	44	-6
Passengers	24	2	-22	24	4	-20	26	11	-15	23	11	-12	30	3	-27	28	0	-28
Reefer ship	1	1	0	2	2	0	1	1	0	10	7	-3	10	11	1	6	7	1
Ro-Ro	17	23	6	12	16	4	21	16	-5	18	13	-5	25	18	-7	22	20	-2
Oil Tankers	540	530	-10	474	439	-35	531	498	-33	460	482	22	517	459	-58	481	378	-103
Chemical Tankers	197	244	47	184	242	58	204	212	8	184	245	61	185	236	51	200	237	37
Gas Tanker	59	42	-17	59	37	-22	70	43	-27	46	41	-5	58	57	-1	36	44	8
Vehicle Carrier	7	12	5	10	7	-3	8	12	4	9	6	-3	6	7	1	8	4	-4

5. Conclusion

Turkey may not be a major oil-producing country, but it is the leading country providing the transport corridor from the Caspian region to western countries. At a glance, it looks like the Straits are only crucial due to the strategic location that acts as a waterway for petroleum products; however, financial, maritime safety, legal and environmental aspects are crucial too. The financial aspect pertains to the Caucasian countries' oil production and the legal aspect to the provision of free passage to all ships during peacetime, as regulated by the Montreux convention of 1936. Furthermore, the environmental aspect is of great importance to the prolific marine species of the Black Sea, Marmara Sea and the Mediterranean Sea, acting as a biological acclimatisation zone between the three.

The Straits are also of critical importance for the world heritage city of Istanbul and Canakkale, with the implicit risks of having the world's most difficult waterways to navigate because of the afore-mentioned meteorological and hydrographical influences and the average 45,000 vessels transiting the straits each year. Oil tankers represent around 9000 passages and chemical

tankers around 2000; therefore, safety and environmental purposes motivated the authorities to impose a new maritime traffic system in 2019. The study shows the importance of the Turkish Strait and discloses the figures on chemical tanker traffic based on actual ship movements from south to north and return.

Finally, the study shows that the ship type most affected by COVID19 was passenger/cruise ships, and the least affected type was Chemical tankers. However, some suggest that this is partly due to chemical tankers carrying refined products and materials used for the production of hygiene-related products such as disinfectants and sanitising gels.

NOTES

1. There is a present debate for the new project "Istanbul Canal" stating that in case canal is built, then Montreux will be overruled and no longer may applicable so signed parties bring a new debate by stating that the Montreux Terms will be no longer valid?
2. A 2020 Vision for the Black Sea Region.
3. https://www.mevzuat.gov.tr/MevzuatMetin/21.5.1426.pdf.
4. He was a Legal adviser to Russian Department of Foreign Affairs 1869–1909. Principal works include Consuls and Consular Jurisdiction in the Orient (1873). Source https://www.oxfordreference.com/view/10.1093/oi/authority.20110803100136743.
5. http://www.afcan.org/dossiers_techniques/tsvts_gb.html.
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