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Analysis of Hydrometeorological Conditions in the Main Georgian Poti Port, its Impact on the Cargo Turnover and Ways of Solutions

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Abstract: A favorable geographical position Poti port and increase cargo turnover should be provided by maintenance of safety navigation and minimal influence hydro meteorological conditions. The influence of prevailing wind directions – East and West, constant sea currents allows the waves to deposit the sediments in the entrance channel and that the most important unfavorable meteorological conditions contribute to closing the port for navigation for several days. Paper presents the analysis of hydrometeorological conditions for the creation of technical decisions which can be conducted in Port of Poti to provide the safety navigation, decreasing besieger's sediments in the entrance channel and cases of closure of the port for navigation. The presented paper continues the previous three papers - "New Black Sea Terminal of Port Kulevi and it Navigating Features", "Analysis of Hydrometeorological Characteristics in Port of Kulevi Zone" and "Mathematical Modelling of Wave Situation for Creation of Protective Hydrotechnical Constructions in Port Kulevi" where considered the aspects of safety navigation provision Kulevi port. Ports Kulevi and Poti are at close range of each other and for analysis of hydrometeorological conditions in the Poti port possible to use the results of research that are presented in these three papers.
Keywords: Poti Port, Hydrometeorological Conditions, Bulk Cargo.

1. Introduction

Geographical position of Georgia - Asia, the Near East and Europe crossroads and presence of already existed means of communication between Georgia and oil producing regions - Kazakhstan, Turkmenistan and Azerbaijan, also the necessity of search and the creation new alternative ways of safe transportation of oil to Europe and especially container cargos from Europe to Asia grants special responsibility the main Georgia cargo Poti port.

Operator of Poti port is APM Terminals. APM Terminals, along with Maersk Line, DAMCO, Svitzer and Maersk Container Industry combine to form the Maersk Transport and Logistics business unit [9].

In 2018 APM Terminals Poti (APMT) and the Poti New Terminals Consortium (PNTC) signed a Memorandum of Understanding for a USD $100 million-dollar investment in a new bulk cargo terminal. The facility will have an annual capacity 1.5 million tons of dry bulk cargo [9].

In 2020 APMT and PNTC have signed an agreement for the joint development of a new bulk cargo facility on the northern side of the Poti Sea Port, APMT will invest in constructing a new breakwater, 400 m of quay wall and dredging up to 13.5 meters vessel draft, and PNTC will invest in building a new dry and bulk cargo facility including extensive yard area and rail connection in Poti [13].

2. Analysis of meteorological and hydrological conditions

The hydrometeorological conditions in the ports of Kulevi and Poti do not differ from each other. The results of studies presented in [7], [8], [10], [11] and [12] were used to analyze the hydrometeorological conditions in the port of Poti.

Winds. The collection and analysis of wind conditions (direction, speed, maximum and minimum values) in the port of Poti was carried out using daily data received from the State Hydrographic Service of Georgia from the meteorological station located in Poti. Data on the wind regime (daily, weekly, monthly, semi-annual and annual) were processed, calculated on average and built into special graphs. With the help of graphs, the prevailing direction, maximum and minimum wind speeds were determined in different periods of time.

The collection and processing of data on the wind regime was carried out during the annual period from 2020 to 2021 (See Tab.1.).

Table 1. Time period for collecting and processing data on the wind regime

Half-Year	Half-Year	Annual	Summer	Autumn	Winter	Spring
01.07.2020 – 31.12.2020	01.01.2021 – 31.08.2021	01.07.2020 – 31.08.2021	01.07.2020 – 31.08.2020	01.09.2020 – 01.11.2020	01.12.2020 – 28.02.2021	01.03.2021 – 31.05.2021

Wind directions is distributed in the following way (See Tab. 2, 3, 4, 5, 6, 7).

Table 2. Distributed wind directions

Half-Year – A – 01.07.2020 – 31.12.2020									
Wind Direction	ESE	E	WNW	WSW	SSW	W	SSE	S	ENE
%	30.6	16.8	8.7	6.3	5.1	6.9	8.1	4.0	4.9

Table 3. Distributed wind directions

Half-Year – B – 01.01.2021 – 31.08.2021										
Wind Direction	ESE	E	WNW	WSW	SSW	W	SSE	NNW	S	ENE
%	22.7	15.8	10.5	8.9	8.1	7.7	6.7	5.2	4.2	4.0

Table 4. Distributed wind directions

Annual – C – 01.07.2020 – 31.08.2021										
Wind Direction	ESE	E	WNW	WSW	SSW	W	SSE	NNW	S	ENE
%	26.6	16.3	9.6	7.6	6.6	7.3	7.4	4.6	4.1	4.4

Table 5. Distributed wind directions

Winter – D – 01.12.2020 – 28.02.2021						
Wind Direction	ESE	E	SSE	WNW	W	NNW
%	38.8	24.5	6.4	6.8	4.5	3.8

Table 6. Distributed wind directions

Spring – D – 01.03.2021 – 31.05.2021										
Wind Direction	E	ESE	WNW	WSW	SSW	W	NNW	SSE	ENE	S
%	16.9	16.5	11.8	10.8	9.1	8.3	8.9	4.9	4.7	4.5

Table 7. Distributed wind directions

Summer – D – 01.07.2020 – 31.08.2020									
Wind Direction	ESE	WNW	WSW	W	SSE	E	SSW	S	NNW
%	21.9	11.3	10.9	11.6	9.8	10.5	9.1	5.8	3.9

Prevailing directions of the wind, as it can be seen in the tables of distributed wind directions are the ESE, East, WNW and West.

The average speed of the wind is mainly between min – 2.5 м/s, max – 10.1 м/s and it is acceptable for safe entrance and leaving and quite lower than criteria of safety safe maximal wind speed.

Direction of entrance channel of Poti port and prevailing directions of the winds are the same, allowing the safe entrance and leaving of the ships.

According Poti Port Regulations during the wind strengthening to 17 m/s, and reduction of visibility less than 0,5 miles, as well as, waves exceeding sea force 5 by Douglas scale at the entrance channel the Port access and exit are prohibited.

Observations show that the duration of the maximal indicators of the wind is between from 3 to 8 hours and the change of the wind direction the speed decreases to the average indicators of – 4. 5 м/s – 6.0 м/s. The longer wind is detected from West, ESE, and East. They may blow during 2-3 days, sometimes for 5 days, in the period of June-October.

Storms. The stormiest period is the period from November to March. The least number of the storms is in the summer – July-August. The bigger duration of the storm is in November and December and is 5 days (117 hours). The most often stormy winds are from the East – they repeat in more than 70%. The winds of wave-dangerous direction are the wind of western quarter and South-West. Stormy West and South-West winds repeat in 13-15%; strong stormy winds with the speed more than 18м/s are mostly detected from South-West.

Air's temperature regime. Average annual temperature – 14.2°, the hottest month of the year –is August (average temperature – 23.3°, maximal – 37.3°). The coldest months are January, February (average temperature – 6-7°, minimal temperature -10°, in February).

Precipitation. Maximal amount of precipitation is in August-September (240-250 mm, on average, absolute maximum – 614 mm – in September). Absolute 24-hours maximum – 268 mm. Average annual amount of precipitation – 1661 mm.

Fogs. The fogs are detected in the spring in majority. The biggest average annual amount is detected in March – 3. There are 18 foggy days on average, in some years – up to 37 days.

Water Temperature. The highest temperature is detected in July-August (average temperature 24-25°, maximal – 29.4°), the average temperature in the coldest months – January-March is 7-9°, the lowest – 2.8° (February).

Salinity of water. Regime of water salinity plays an important role in hydrodynamical processes of the shore as well as in navigation in water area. Salinity of water is 14, 25 prm, which increases in the winter, at the lowest cost (the average salinity - more than 15 prm, maximum 19.7 prm). The lowest salinity observed in May and June, during the spring flood river Ronni-discharge (average salinity - the order of 11-13 prm, the minimum 4.85 prm).

Heavy Sea. The analysis of hydrometeorological characteristics shows that the main factor, which influences upon the level of safety of navigation on the approaches to the water area of Port of Poti is heavy sea ([4], [6]). Wave situation determined by the wind waves and swell. The repeatedness of the West and North-West roughness are change only by 2.5% and 9%. The repeatedness of South-West in the spring-summer period increases up to 35-40%. In the cold period of the year on account of active influence of the west winds the wave regime increases. The height of the waves is about 2.0 м which is 2.0% in the winter period of the year. In the warm season, the maximum parameters of the waves are observed, mainly in the South-West of waves, the action of the South-Western, Southern and Western winds. The maximal parameters of the waves as a rule are connected with the wind-caused waves, which parameters are bigger than waves of swell. Average monthly repeat of the wind waves are 36-48%.

Currents. They are two major types of current: sea current, caused with the water circulation in the Black Sea (in the presented case – from South to North) and local shore current. Countervailing currents are connected with the wind surges and directed to the sea. In case of permanent activity of heavy West and South-West (as a rule not less 12-18 hours) wave – along shore currents arise, which direction is constant, and speed reaches 1.0-1.5м/s.

The dynamics of sediments. The dynamics of sediments in Port of Poti is determined by the firm drain of the river Rioni. River Rioni mainly brings the beach-forming solid material to the coastal zone and the

channel entering the port. 310.000 m³ of solid material averagely flows into Poti Sea Port per annum. River Rioni is the biggest river of the West Georgia. It forms the delta, where it joins with Black Sea, near Poti. River Rioni is characterized by large amount of sediment - its overall average annual solid sediment load amounts to 5 million m³, respectively. 10% of them represent the bottom sediments. Volume of beach-generating 0.1 mm diameter fraction amounts to 1.2-1.4 million m³. The transportation is made through river flow across the coast, as well as at the cost of the Rioni sediment. The hydrological observations are underway at Rioni northern branch during the recent years ([3], [5] and [14]).

3. Poti sea port

The Poti Sea Port is the largest port in Georgia, handling container, liquids, and dry bulk cargo and passenger ferries. The multi-purpose facility has 15 berths, a total quay length of 2900 meters, more than 20 quay cranes and 17 km of rail track ([9]).

Navigation regime ([1]), in order to prevent collisions at sea, every ship shall observe safe distance from ships entering/leaving Poti port and not impede their movement. Traffic separation system applies between anchorage points in the port of Poti. The aim of the system is to regulate movement of ships in this area, and to prevent opposite movements of ships entering and leaving ports.

The Poti Port ([2]) includes Southern and Northern docks, internal pool, south, west and new north mall, entrance channel and external roadstead. The Poti Port area consists of protected and open parts, where Poti Sea Port Corporation, APM Terminals Poti and New Sea Port of Poti are located (Fig.1.).

The maximum allowable dimensions of the vessels entering the Poti Port: length 240 meters, width 35 meters and draft 10.3 meters and today, after dredging, the maximum draft is 12.5 meters.

The entrance/departure of the vessel, more than 180 meters in length and/or with more than 9.0 meters draft, in the Poti Port is allowed only in the light period of the day. The entry/departure from Poti port and tying is allowed day and night for railway, automobile and transport ferry, which is equipped with two main engines and two oar screw, also by front adjoining crafts, the maximum length of the ship shall be 195 meter and the draft 8 meter, in good hydrometeorological conditions and with the ship master's approval, only in №2 railway ferry wharf.

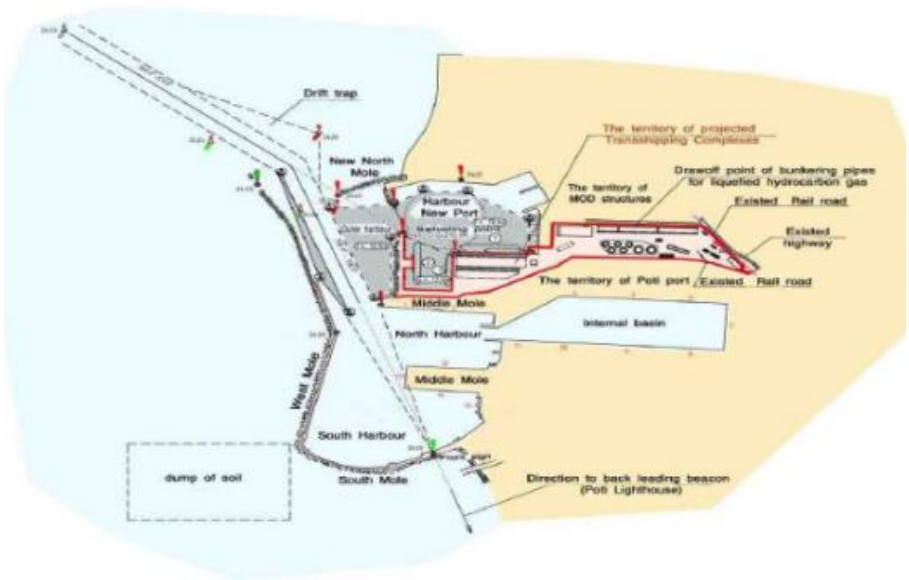

Fig. 1. Layout plan of the Port of Poti and New Sea Port of Poti ([14]).

Container ship with approach equipment, can enter/ leave the port of Poti only at container berth No. 14, During any time of the day-night, The maximum length of the vessel is 190 meters and maximum draft 8.5 meters if wind capacity does not exceed 10-12 m/s, in case of ship's master's consent.

During the wind strengthening 17 m/s access and exit from the Port are prohibited. The departure/entry of ships from the port is decided by the harbour Master considering factual weather conditions and with the agreement pilot. The ferry traffic and mooring operations in the Port, as a rule, are conducted in the wind direction, which shall not exceed 10 m/s.

The maximum safe speed of the vessel in the Poti Port is 5 knot. In the entrance channel of the Poti Port receiving of marine pilot and operations of the ship entry/departure in/out is permitted on the following conditions:

a) There is a Joint Agreement between harbour master, pilot and Ship master;

b) Pilot tugboat has maneuvering characteristics for marine pilot's embarking and disembarking on the vessels;

c) When the wind blows Eastward, the pilot's embarkation aboard and the ship entry/departure in/out operations is permitted, if the wind speed not exceed 17 m/s (wind force 7 by beaufort scale);

d) In case of unfavorable climatic conditions ship's entry in the port is prohibited, if the wave height exceeds 4 meters by Douglas scale.

The water area of Poti Port ([2]) (42°09'N, 041°39'E) is surrounded by the seashore, φ= 42°12' N parallel (outfall of Rioni River), φ=42°08' N parallel (channel of Rioni River), direct line from the sea, which goes to the point, which is aligned from two miles of the coast line of the above mentioned parallels and encompasses:

a) Northern dock – port water area, which is made by the sea area and is set between western mall, northern mall (№1 and №2 wharves and middle mall (№12 and №13 wharves);

Table 8. Profile and Characteristics of Berths Poti Sea Port Corporation, APM Terminals Poti

Berth №	Type of Cargo	Berth Characteristics	
		Length (m)	Depth (m)
1	Oil and product	200	12,5
2	Chemical cargo and ro-ro terminal	183	12,5
3	Bulk cargo	215	8,5
4	Bulk cargo	154	8,5
5	Bulk cargo	173	8,5
6	Bulk cargo	212	9,75
7	Containerized cargo	211	8,25
8	Bulk cargo	215	9,75
9	Bulk cargo	220	8,0
10	Bulk cargo	264	8,0
11	Berth	71	8,0
12	Berth	250	6,1
13	Ro-Ro terminal	97	6,5
14	Containerized cargo	253	8,4
15	Wheat delivered to the mill	155	8,5

b) Southern dock- port sea area, which is surrounded by southern, western and middle mall.

c) Internal bay – part of sea area, which is encompassed in the internal dock.

d) New port dock – sea area, which is surrounded by the northern mall, new northern mall and internal western mall. The New Sea Port of Poti and coast guard base are located in the new port dock. New Sea Port of Poti mostly handles container cargo ships, dry cargo ships and ships with bulk cargo. There is a closed storage depot for 50,000 m³ of cargo on the berth, equipped with appropriate modern systems to supply the ship in bulk (including hazardous bulk) cargoes such as: urea, granulated sulfur, etc.

There is also a train track along the warehouse, and the equipment for emptying the wagons (method of emptying the bottom point) is located directly next to the warehouse, through which the cargo unloaded from the wagon enters the warehouse hangar through a special cargo strip. The New Sea Port of Poti also plans to develop the existing infrastructure and accept ferry vessels in the future.

Table 9. Profile and Characteristics of Berths the New Sea Port of Poti

Berth №	Type of Cargo	Berth Characteristics	
		Length (m)	Depth (m)
1	Containerized cargo	245	12.5
2	ro-ro terminal	210	5.0
3	Bulk cargo	120	2.5
4	Berth	25	6.0
5	Bulk cargo	150	3.5

e) The port entrance channel consists of two legs: the first leg width is 100 meters, depth 10.5 meters, axis direction 129°-309°, length 5 cbl (926 meters), the other leg's width is 50 meters, depth 10.5 meters, axis direction 158.9° -338.9°, length -3.5 meters (648 meters).

Anchorage Areas and Points: ([2]) the north district №200 – is intended for only tankers and/or vessels loaded with dangerous goods; the south district №300 – is intended for the dry cargo vessels.

There are two anchorage points designated for the vessels to conduct a cargo operations while standing on roadstead: point №1 φ = 42°09,'6 N; λ =041°38,'0 E 16 meters in depth and №2 φ = 42°09,'6 N; λ=041°37,'3 E 15 meters in depth. The Pilot performs the vessel disposal in the above-mentioned points by the claim of the Master.

The Poti Port operates during day-night time, without weekend and holidays. The Pilotage and provision of a towed service for the vessel are mandatory.

It is prohibited producing of towed operations in the Poti Port, if the wind speed exceeds 17 m/s. In the cases of a ship helm, anchor and the main engine failures towed operation performance is permitted, if the wind speed does not exceed 10 m/s.

4. Statistics of ship calls and cargo turnover in the port of Poti

As the Port of Poti in the point of view of hydrometeorolgical conditions is a difficult one. Unfavorable meteorological conditions contribute to closing the port for navigation for several days. This leads to a decrease in freight turnover.

Below is the statistics of cargo turnover and duration of unfavorable metrological conditions from July 2020 to September 2021 in the port of Poti.

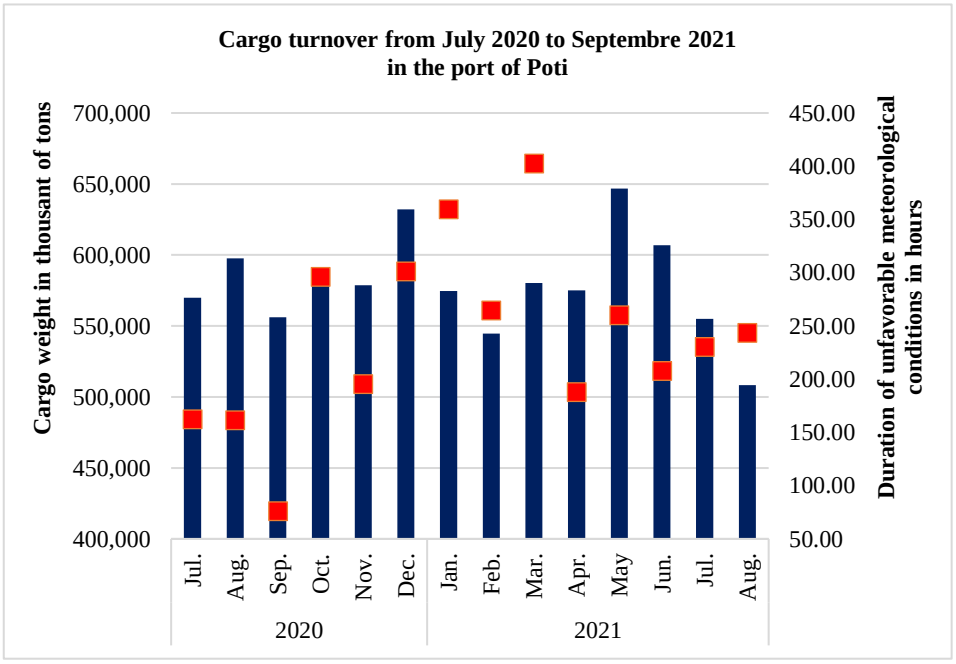

Fig. 2. Statistics of cargo turnover and duration of unfavorable metrological conditions from July 2020 to September 2021 in the port of Poti

An analysis of the observations and statistical indicators of cargo turnover show that in the study period from July 2020 to September 2021, official data on the duration of adverse meteorological conditions should have decreased in cargo turnover in the port of Poti, however, in most cases when they were announced adverse meteorological days, the port of Poti worked on actual weather conditions, due to which we do not observe correlation in statistics of cargo turnover and duration of unfavorable metrological conditions (Fig. 2.).

Conclusion

It is possible conclude, that a favorable geographical position Poti port and increase cargo turnover should be provided by maintenance of safety navigation and minimal influence hydro meteorological and hydro logical conditions:

- The main factor, which influences upon the level of safety of navigation in area of Port of Poti is heavy sea.
- The duration of the maximal indicators of the wind is between from 3 to 8 hours and the change of the wind direction the speed decreases to the average indicators of – 4.5 м/s – 6.0 м/s.
- The configuration of the moles of Poti port and the New Sea Port of Poti, considering into account the reconstruction, secures the approach to the harbor of the waves of N and NW storms of the height of not more than 0.4-0.2 m.
- The sediment near the port of Poti is caused by the solid runoff of the Rioni River. The main settling of sediments occurs in the inner water area, as well as on the inlet channel, therefore it is necessary to measure the depths at the port entrance and in the inlet channel twice a month, and after each storm.

References

[1] The Government Decrees № 78 on "Establishing the Navigation Regime and Navigation Rules in the Territorial Sea of Georgia". Tbilisi, 2019;

[2] Maritime Transport Agency of Georgia, Director Order №019 on approval of "The Port Rules". Batumi, 2012;

[3] Dzhaoshvili S. "Hydrologic-morphological processes in mouth zone river Rioni and their anthropogenesis changes". Water resources, w.25, №2, 1998;

[4] Varazashvili N. "Geological processes and the phenomena in a zone of construction of sea hydraulic engineering constructions and actions on improvement of a coastal situation". Engineering geology (excerpt). Academy of Sciences the USSR. Moscow, 1983;

[5] Dzhaoshvili S. "New data about beach formed sediments of a coastal zone of Georgia". Water resources (excerpt). Academy of Sciences the USSR. Moscow, 1984;

[6] Materials of supervision over elements of a hydrometeorologcal mode for the period 1971-1999. (Information of Poti mouth stations);

[7] Bach H., Christiansen P. "Numerical investigations of creeping waves in water theory". ZAMM. New York, 2004;

[8] Mathematical modelling of hydrological characteristics in the port of Kulevi. LLC "Anchor". Kulevi, 2009;

[9] APM Terminals Poti. https://www.apmterminals.com/en/poti/;

[10] Gegenava A., Varshanidze N., Khaidarov G. "New Black Sea Terminal of Port Kulevi and it Navigating Features". TransNav 2009, Gdynia, 2009;

[11] Gegenava A., Khaidarov G. "Analysis of Hydrometeorological Characteristics in Port of Kulevi Zone". TransNav 2011, Gdynia, 2011;

[12] Gegenava A., Sharabidze I., Kakhidze A. "Mathematical Modelling of Wave Situation for Creation of Protective Hydrotechnical Constructions in Port Kulevi". TransNav 2015, Gdynia, 2015;

[13] APM Terminals Poti signs contract for dry bulk facility. https://www.apmterminals.com/en/news/news-releases/2020/201023-poti-bulk-terminal;

[14] Multifunctional Transshipment Terminal at Port of Poti, Georgia. https://www3.dfc.gov/environment/eia/potiport/Poti_ESIA_Final%20Draft_21Nov2015.pdf