STUDY REGARDING THE INCREMENT OF LIQUID CARGO TRANSFER THROUGH PORT OF MIDIA SPECIALIZED BERTHS

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Abstract: *The continuous development of Petromidia refinery requires new technologies and logistics to be used beginig with 2012 in order to increase the refining capacity with more that 1 million tons of crude oil per year. A new Oil Terminal consisting in an Off Shore Single Point Mooring (SPM) has been builded off Port of Midia limits, terminal that facilitate the import of the necessary crude oil quantity for the refinery reducing the handling costs and minimalising losses. Considering that Port of Midia has been projected to accommodate ships of max 10.000 tdw, measures will have to be taken in order to create the posibility to export larger quantities of liquid products. New specialized berths will have to be builded or the actual configuration of the port basin will have to be changed. This paper is presenting few solutions for the above mentioned points.*
Key words*: Port of Midia, liquid products, berths, dredging*

1. INTRODUCTION

The second larger Romanian port on the coast of Black Sea, Port of Midia, has been conceived stricltly to serve the industrial purposes of the former petrochemical combinat Midia –Navodari. The entire harbour cover an area of 834 hectars, out of what 600 hectars beeing water surface and the rest of 234 ha being dry land. There are two breakwaters (North and South) with a total lenght of 6.97 Km.

The maximum deadweight allowed to berth in the Port of Midia is 7500tdw for cargo vessels and 10.000tdw oil tankers. The crude oil import as well as the refined products export were done innitially through Constanta Oil Terminal, using the oil tank farm and the pipeline system of the above mentioned. Goods transport between Midia and Constanta use to be made by rail.

Due to poor maintenance of the pipeline system and the cargo handling requested fees by Constanta Oil Terminal the final price of the refined products began to increase more and more at the same time the tehnologic loses during the transport being higher.

Considering the above mentioned, Rompetrol S.A., the most important comercial operator in Midia Harbor, has applied through his subsidiary „Midia Marine Terminal" a series of mesures in order to fulfill the goal of a good competitivity on the international market.

The new organization and technological development of the Petromidia Refinery as well as the installation of a new offshore terminal consisting in a Single Point Mooring off Port of Midia limits, and three new oil tanker berths inside the horbour has conducted to a positive performance of the refinery [1].

The refinery activity has increased continously and begining with 2013 the refining capacity will increase with abouth 1.500.000 tonnes per year the Rompetrol S.A. reaching the performance of refining abt 5.000.000 tonnes per year.

2. ACTUAL SITUATION

The import of the extra quantity of crude oil can de done easily through the offshore terminal that was commisioned in 2008, where Oil Tankers of 150.000 dwt can be operated.

The essential problem of the refinery is still the export of the extra quantity of refined products resulted, considering that the larger tanker accepted to operate in the Port of Midia is 10.000 dwt.

Port of Midia is administrated by the National Company - S.A. Maritime Ports Administration (CN-APM-SA) Constanta, as cessionary of Ministry of Transportation and Infrastructure, cession that represent all the projects regarding the harbour infrastructure (breakwaters, berths, basins,and other terittory). Superstructure work is done ussualy by the port operators, all the companies that are deploying their businesses inside the romanian ports being liable for their assets.

Prezently the Midia Marine Terminal operator is carrying out its work ar berths no 1-4, 9A, 9B and 9C. Along the berths 1-4 it is maintained a depth of 9.5 metters that allows the vessels to sail with a draft of 9.00 m. and at the berths 9A and 9B can be operated tankers of a maximum deadweight of 10.000 dwt but with a draft of max 8.00 metters, the deptht alongside and in basin being maintained at 9.00m.

Berth 9C is specialized to operate barges (liquid cargo) with a draft of max 4.00metters, maximum depth alongside and in the channel being 5.00metters, the mentioned barges having acces to the Poarta Alba – Midia - Navodari Cannal and after that to Danube – Black Sea Canal.

The berthing front of the berth 1-4 is 569 metters in lenght, the pier is gravitational type with a vertical parament buided with prefabricate concrete blocks of abt 100tonnes each, mounted one over the other and consolidated at the superior part with another layer of soft concrete that grasps all the fender supports and the tehnological cannals of pipeline systems as well as the bollards used for ships berthing.

The fairway along the berths 1-4 is 100 metters wide and 220 metters in front. Of the no 4 berth. Berth no. 9A is located on the east part of mol no.1, it is 204 metters in lenght and allows the safe berthing of the oil tankers of max 10.000 dwt and approx. 150metters in lenght. 9B berth on the south side of the acces breakwater, specialized on liquid cargo transfer,has a total lenght of 205.1 metters and consists in a central platform and 4 d'Albi type dolphins, two on each of the central platform. 9C berth is 37.9 metters in lenght and it is designed to operate tanker barges up to 4000 dwt.

Presently the projected dephts in the harbour basin are not longer conform with the reality. Along berth no 1, at a distance of approx 8.8 to 10 metters in transversal section there is an ambankment of abt 1:6 until the depth of the basin reaches 3.5 metters, outside the fairway.

Inside the harbour in the fairway limits the depths are varying between 9.00 to 9.50 metters with highs and lows that are reaching 8.6 metters. The aproaching cannal, 100 metters wide, from the end of breakwater till the fairway buoy depths are varying from 9.50 up to 11.50 metters.

The aproaching cannal clogging takes place due to the bottom longitudinal currents that are carrying large amount of mud and sediments. This current flows along the north breakwater on a SE-ly direction till the end of it and after that the current turns in a whirpool, speed drops and the sediments deposits remains reducing the water depths.

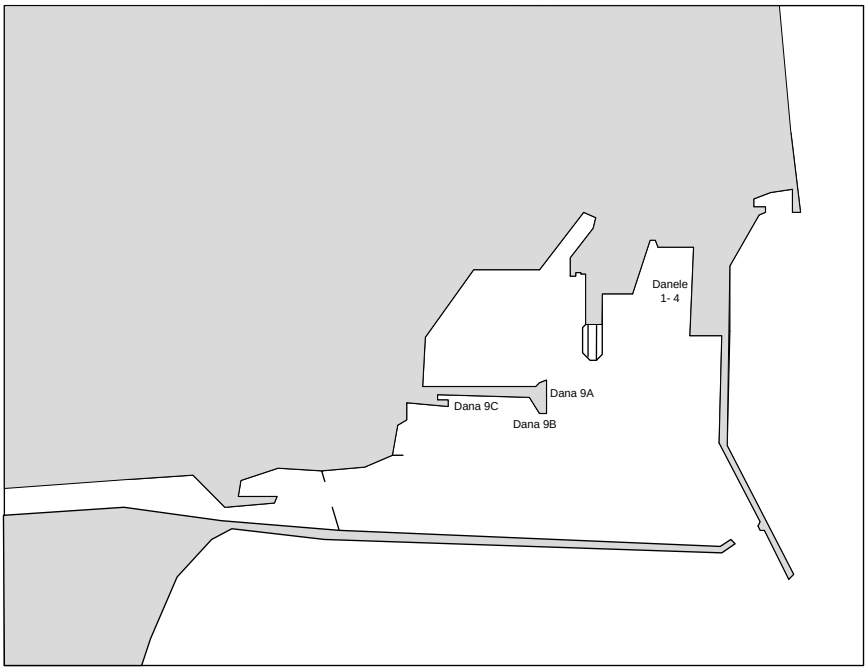

Fig. 1. Port of Midia with oil takkers berths.

3. CONSTRUCTIV SOLUTION

For a safe berthing of the vessels with a maximum draft of 8.50 metter and the lenght of 190 metters, at the operational oil tanker berths, the following constructive solution can be considered:

Execution of a corrective dregging so that the depths in the fairway, in the port basin and along the berths no 1-4 and 9A,9B and 9C to mach the the projected cotes.

There will be considered a standard oil tanker of 35.000 dwt, of 197 metters in lenght, 28.5 m width and a maximum draft of 11.10 m. And the following port developments will have to be made.

1.Fairway correction

2.Incremenent of turming basin diameter.

3.Relocation of all the lateral buoys (port and starboard) along the fairway.

4.Performing the corrective dregging.

5.Specific work on the oil tanker berths.

The oil tanker will enter the harbour and will proceed straight aheaduntil she will reach the turning basin area where will be rotated with 180 degrees and after that will be towed by stern towards the operating bert where she will be moored with the shoulder against the exit.The turning basin diameter as well as the fairway bents radius will have to be corrected in order to assume a safe in and out manoeuver of the commercial tankers.

Cannal width is calculated using the folowing formula:

$$Bs = Bn + Ln \cdot \sin\alpha + 2\Delta B$$

where:

Bs – the width of the channel

Bn – Ship's beam

Ln – Max ship's lenght

α – drifting angle

ΔB - lateral safety space

$$Bs = 28,5 + 200 \cdot \sin 6^{\circ} + 2 \cdot 28,5 = 106,5m$$

The turning basin diameter will have to increase to 300m (1.5 Lmax), and minimum two tugs, (sametines three), depending of the weather condition will assist the manouver. Basin and fairway limits changing will automatically imply the relocation of the lateral buoys and some extra ones will have to be fitted in certain positions.

Considering the existing mooring conditions on berth no 9A and 9B, only brest and spring lines can be send to the shore bolards. Fore and aft ropes can not be made fast due to actual lenght of the berth. Considering the above mentioned, deployment of two mooring bouys is necessary. One will be deployed at the north end of berth no 9A, at least 30 metters from the end of the pier and the second one, for the berth 9B 30 metters towards the west end of the pier.

The fairway and turning basins dimensions depends of a series of factors as follows:

- Prevailing winds in the area of interest.
- Ship's particulars
- How many tugs will assist the maneuver.
- Cargo characteristics.

All the necessary allowances (wind and current influences) will have to be considered when calculating the channel dimensions ,for a safe transit in and out of the port.

The fairway in front of the operational berth has to offer the posibility of berthing and unberthing (turning the ship if required) and when there is a vessel under operations, the width of the navigational channel has to permint the safe sailing of the vessels of 10.000 dwt.

The width of the channel will be calculated with the formula:

$$Bb = Bn + A + Bn_1 + 2\Delta B_1$$

where:

Bb – width of the basin

Bn – Ship's beam

A – redemption space
Bn_1 – Sailing vessel beam (10.000 dwt)

$\Delta B_1 = 1,5 \cdot Bn_1$ - safety distance from the moored vessel and from the basin limit.

$$Bb = 28,5 + 0,5 + 19 + 2 \cdot 28,5 = 105m$$

While departure from berth, the ship will open first the bow under an angle of 15-20 degrees, and after that the manoeuvre will take place as allwayse. The resulting space will be :

$$Bb = Bn + Ln \cdot \sin\gamma + \Delta B$$

γ - opening angle.

$$Bb = 28,4 + 200 \cdot \sin 15^{\circ} + 28,5 = 108,6m$$

In the fairway will consider the width as being*Bb*=100 metters.

Out of the harbour we can consider larger lateral reserves up to 28.5 metters, acording with 35.000 vessel beam. Using a higher speed, the drift will be reduced to max 4 degrees and the fairway width can go up to *Bs*=99,5 metters.

To determine the turning basin area will consider the fact that two tugs will be used to assist the manouvre resulting a circular area with a diametre of 1,5*Ln*=300m. A safety space of 0,5*Ln*=100metters will be added resulting a poligonal surface with minimum distances on any direction. This basin will be in addition of the one in front of the berths 1-4 , on the direction of port entrance.

The depth of the fairway depends of the maximum draft, cargo distribution and the sinkage of the ship generated by wind, waves, current, and ship's speed.

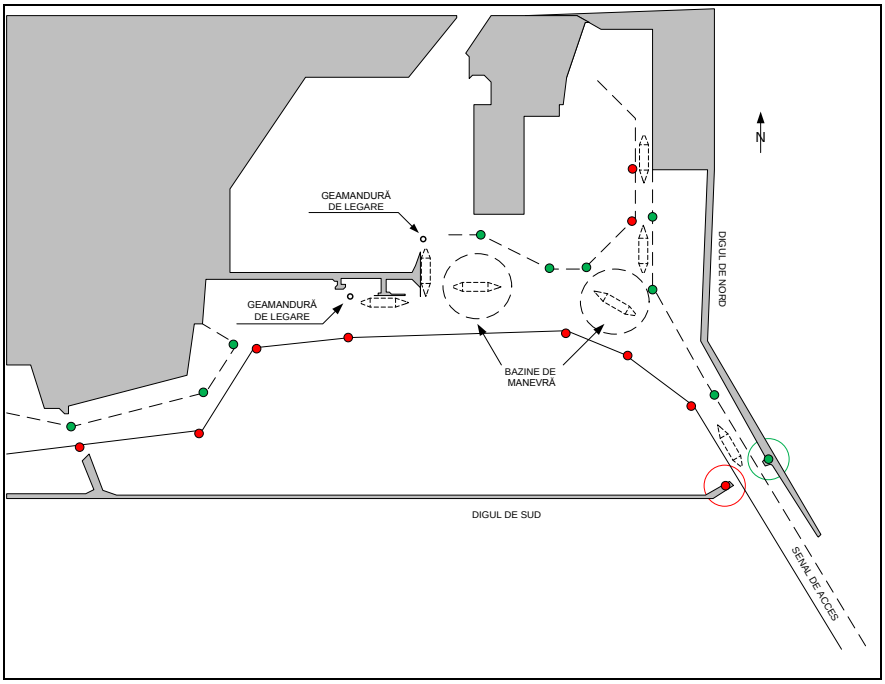

Fig. 2. Midia Port layout to accomodate ships wint a LOA of 200m and max draft of 8.50 m

The maximum depth necessary for a vessel of 35 000 tdw in the Port of Midia, included all the preserves will be calculated using the following formula:

$$h = T\max + \sum_{i=1}^{5} z_i$$

h- maximum water depth considering medium Black Sea
Tmax – Ship's maximum draft
z_1 – net pilot reserve
z_2 – Wave reserve
z_3 – Speed reserve
z_4 – Current reserve
z_5 – Sediments reserve

Maximum draft of a vessel of 35.000 dwt is 11.10 m. Considering water density of 1.02t/m^3, the measured draft will be reduced compared with the draft in fresh water with approx 2%.

Net pilot reserve represent the water layer that has to be maintained at all times under the keel and depends of the ship's draft and the bottom nature. Ship's draft is 8.50 m. and the bottom if fine sand.

- Off Port fairway z_1= 0,04 x Tmax = 0,34m
- In Port fairway z_1= 0,04 x Tmax = 0,34m
- Turning basin, in front of the berth z_1= 0,03 x Tmax = 0,25m

Wave reserve depends of the navigating area. Off port limit the wavescan reach 4 metters in high . Inside the harbour, in the turning basin area waves can reach 1 metter and in front of the operative berths 0.3 up to 0.5 metters.

- Off Port fairway $z_2 = 0,57m$
- In port fairway $z_2 = 0,05m$
- Manouvering basin in front of the berth $z_2 = 0m$

Speed reserve will be considered differently, on each sector.
Outside channel ship's speed will be Vn=3m/s (~6Nd sau 10,8Km/h),
Inside harbour Vn=2m/s (~4Nd sau 7,2Km/h)
Turning basin Vn=1m/s (~2Nd sau 3,6Km/h).

- Off port fairway $z_3 = 0,033 \times 3,6 = 0,12m$
- In port fairway $z_3 = 0,033 \times 7,2 = 0,237m$
- Turning basin $z_3 = 0,033 \times 10,8 = 0,356m$

Curent reserve will be considered zero as inside the Midia harbour there are no curents and outside the harbour there is a weak curent of abt 0.2 – 0.5 acting on N-S direction and the influence on navigation is neglijable.

Sediments reserve will be calculated considering the sand deposits between two consecutive bottom maintenance operations. Off port limit the deposits are considerable , the fairway being situated transversally on the direction of the current. Deposits quantity are abt 1.00 m in three years , which means 0.30 m. per year.

Operational required depths for a vessel of 200 m in lenght and a draft of 8.50 m. in Port of Midia.

Tab. 1 Necessary depths in Port of Midia

No.	Area	Draft max. [m]	Depth reserves [m]					Depth total [m]
			Pilot	Wave	Speed	Sediment	Total	
1.	Berth Basin	8,5	0,25	0	0,120	0,2	0,57	9,07
2.	Fairway inside harbour	8,5	0,34	0,05	0,237	0,3	0,927	9,43
3.	Off port fairway	8,5	0,34	0,57	0,356	0,3	1,566	10,07

Work to be done on the operational berths.

Berths 9A and 9B are specialized in liquid cargo handling and ship's of maximum 10.000 dwt can be operated alongside, maximum LOA of the above mentioned being 140 m.

For a safe ship operation of the vessels stationed in berth 9A and 9B with a total LOA larger than 140 m (up to 200 m.) the head lines and stern lines will have to be fated in the longitudinal exterior of the berth fact that will impose the installation of a two new mooring buoys, one at each end of the pier.

Having in mind that the south end of berth 9A is located in the 9B berth basin, the longitudinal moorings of the berted ship will be done as follows:

- head lines will be sent to the south cornet bollard.
- stern lines will be fastened to a mooring buoy anchored north of the buoy at a distance of min 55m. from northerly corner.

Same thinking will be applied for berth 9B where the stern mooring lines will be sent at the southerly end bollard of the berth 9A and the head lines will be fasted on a mooring buoy situated west of 9B at a 30 m. distance from westerly corner.

4. CONCLUSIONS

Increment of quantityes offlanded through Port of Midia is on account of continuous enlargement of the refined amount of crude oil , commencing from 2013 when a suplementary quantity of one million tonnes will be added yearly. Using bigger export tankers , enlargement of capacity can be obtained without any higher stocks ashore to be managed.
The work mentioned in this paper is the only solution for the safe operation of the tankers with LOA of 200 m. and 8.50m. draft at the operational berths in the Port of Midia.

REFERENCES:

[1] http://www.portofconstantza.com/apmc