Mathematical meteorological assessment on measurement of tidal Currents in Port management – An evidence from Albania

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Abstract

Contamination from eddy currents due to the presence of electromagnetic fields is a recent phenomenon. Nowadays, these types of pollution cause considerable damage in terms of: malfunctioning of equipment and their damage, damage to marine flora and fauna, human society, and others. Recognition of these phenomena takes on particular importance for marine environments when investing and increasing demand for services provided by these facilities. Our study aims at assessing the spillage caused by electromagnetic fields by considering the meteorological factors and the quality of the ground-to-air port facilities. An important part of this study is the results obtained on the electric field intensity values, the magnetic field intensity, the electromagnetic radiation in the harbor spaces, through direct measurements with the Electro-smog TES-92 measuring instrument, as well as the absolute humidity values, temperature, atmospheric pressure and electrical resistance in these environments by means of the Thermo-hygrometer and the Barometer (atmosphere) PCE-THB 40. The work presents a complete picture of the impact of meteorological factors, temperature, atmospheric pressure and moisture content in these environments, specific resistance values, electrical conductivity and the level of pollution. Based on concrete measurements of meteorological factors and the change of specific resistance values in these spaces, we have been able to interpret the different levels of pollution from the winding currents for the seaports of our country.

Keywords: electrical resistance, electromagnetic pollution, electricalpollution, meteorological factors.

Introduction

Albania's prospects, as a country with a long coastline and with a very special geographic position, impose and favor the construction of a sustainable, safe, optimum, environmentally friendly, integrated, regionally-owned maritime transport system, and Europe, accessible to all, to contribute to the economic growth of the country, as well as to the quality of life of citizens.But important for the Albanian government's policy on transport, remains a crucial condition for the preservation and protection of the environment as a vital factor for the protection and preservation of human life, flora and fauna and the whole ecosystem. But with industrialization, the use of electromagnetic fields is widely spread.

Machinery, equipment, manufacturers of electromagnetic fields as well as television, radio, mobile telephony, electrical equipment etc. have increased the presence of electromagnetic waves, environmental pollution and their negative consequences. Eddy currents are electrical currents that derive from electric circuits (Bespalov, P.A and Chugunov, V, 1997)or induced by the electromagnetic fields that are created, or any other type of currents that are generated on earth, water and air from external sources.The source of eddy currents in harbor environments are: electromagnetic fields of machinery and equipment installed, corrosion protection installations, galvanized coating systems and installations, electro welding systems and equipment, induced currents of piping systems extended to port facilities, induced lines of electric cable cables, railway lines, trams, bridge girders, in or near port facilities, and any breakdowns or defects that may arise in port energy systems(Qiu, et al, 2020).All other sources of electricity currents from other electricity consumers near or on the outskirts of the harbor facilities, (houses, other industrial infrastructure) (Bespalov, P.A and Chugunov, V, 1997); (Constable, S and Srnka, LJ., 2007).The level of pollution from the electromagnetic fields and the bias streams depends on: the installed machinery and equipment and their power, by atmospheric factors (temperature, atmospheric pressure, wave, and humidity), salinity content, and presence of electrical defects, magnetic and electrical characteristics of environment (materials).

Streamlining electric waves on land, water and air in portal environments cause damage to the normal work of machinery and machinery where they arise and exist, damages to destructive corroded form, human health injuries, biodiversity damages (flora and fauna), as well as affect the work of machinery and electrical equipment installed in the port(Durnay, C.H and Curtis, J, 1969).The high and significant values of their currents or their density cause not only corrosion as the highest form of destruction in the area of maritime transport, which is damage to marine environments and damage to infrastructure but also causes damage to fauna and flora, people and other injuries that need to be assessed(Chave et al, 1989).

2. Objects and study

The object of our study is the land, water and air spaces of the Port of Durrës, the Naval Port of Vlora, the Port of Saranda and the Port of Shengjin, part of the maritime transport infrastructure in our country. These facilities located in the shores of Albania lying between the Adriatic Sea and the Ionian Sea are important not only as part of the transport structures, but also as important objects for tourism.The study is the object of real direct measurements of the characteristics of the electromagnetic fields created on the seabirds of our country's seaplane, focusing on the pots that have the largest installed electric power, 50 m and 100 m from them, and in separating environments between cities (residential areas) and port facilities. Our temperature monitoring, atmospheric pressure, wave height, absolute humidity in these study points has also been done on our part.

The Maritime Port of Durrës is located in the northern part of the sea bay of Durres along the coastline with an area of 1400 (m) with a surface area of 670000 (m2), an area of 650000 (m2), with an entry channel of 6755 (ml), width 120 m, depth 9.5 (m), limited to light bulbs from its beginning to the waves, while the depth on the port territory is 7.3 (m) to 11.5 (m)Metalla et al, (2015).The Naval Port of Durres is the largest port in Albania that offers all port services. Its port facility consists of 12 marshes with a total length of 2275 (ml) and is able to process about 78% of Albania's international maritime traffic, has a processing capacity of 5,000,000 tons per yearMetalla et al, (2015).

Vlora Sea Portis the second port in Albania of importance, located about90 km south of the Port of Durres and is defined as the second entrance of Corridor VIII. In this port, the processing of ferry boats with passengers and cargo ships is carried out, covering about 10% of the export-import goods. Theport is in the process of developing its infrastructure and superstructure, which include the construction of the piers for ferries and ferry crossings.

The Naval Port of Vlora is built in the Vlora bay and has a total area of 5,300 (m^2) with an aquarium of 5,000 (m^2). Depth minimum of the port 4.6 (m) and the maximum depth, and port 11 (m). The maximum processing capacity of the goods, loading and unloading is 5400 (tons / 24hrs). It is an open harbor with 2 main bridge where merchant ships and ferries are processed: Bridge "0" with dimensions 100 X 18 m, depth 3-11 m; Main bridge with dimensions 180 X (10-m and depth 2-7 m, processing power 300 - 600 000 tons / year. Processing time for ferries averages 4 to 5 hours, while freight vessels 2-3 daysMetalla et al, (2015). The Naval Port of Saranda is the only port in southern Albania and serves the southern cities: Saranda, Delvina, Gjirokastra, Përmet, Tepelenë. The port of the city of Saranda, where the main activities are carried out, has an area of 18 thousand (m^2). The port of Saranda is a secondary port located about 160 km south of the Port of Durres, where ships and goods are processed. As a port within the city with mainly tourist orientation, for processing of passengers, while processing of goods will take place in the bay of Limion (about 3 km from the port of the city). The processing vessel of the goods has a length of 75 (ml) of diving; 6 (m) depth as well as 2000 (m2) processing squares, in which is installed an electro-dynamic with 5 hooks (tons). Ferry with processing areas 15000 (m2), with contemporary parameters of length 180 (ml), diving up to 9(m) depth.

The Naval Port of Shëngjin, located in the northern part of the Republic of Albania, is the only port in this area. Within the port space there are closed storage warehouses with a surface area of 2,000 (m2) and 10,000 (m2) space for storing goods.The terminal of the freight terminal is 2,440 (m2), while the newly constructed passenger with modern parameters is 250 (m2). 600 meters length for processing commercial vehicles, and a length of 260 (m) for fishing gear.The port of Shëngjin has a total area of 3.750 (m2) and the surface of the water basin is 3.500 (m2), with an entry channel of 300 m long and 80 m wide, the total depth reaches 7 (m).The current capacity of the port for the processing of ships is 1,500-2,000(tons / day) (concretely the amount of 30,000 tons of processed cargo per year), vessels of up to 120 (m) can easily be processed.

3. Study methods and measuring instruments

The study is made in 2017 and 2018, according to seasonal quarters due to the characterization of meteorological characteristics. The methodology used is evidencing, statistical and graphical processing of meteorological and electro-magnetic fields in the study points for the two-year period, by pointing out the role of meteorology characteristics at the level of electromagnetic pollution(Durnay, C.H and Curtis, J, 1969); (Tipler, 2004); and (Wang et al. 2017). So, the results obtained have been processed to give a complete overview of electromagnetic pollution in these environments. We conducted our study for a two-year period 2017 and 2018, divided into four time horizons in each quarter to clearly see the role of environmental and metrology characteristics based on study conducted by (Durnay, C.H and Curtis, J, 1969); (Tipler, 2004); and (Furlani, 2001).

3.1. Measuring Instruments

For the determination of the characteristic parameters of the electromagnetic field and the electric currents in the environments taken in the study, we used the electro-smog instrument TES-92.The electro-smog measuring instrument TES-92 is with a three-dimensional spherical frequency wavelength of 3.5 and serves to indicate the average value in three directions. It is a frame that saves and gives 99 values of the front measurements. For the values we seek to receive, this device requires the boundary values that it ascertains when it is notified through the LCD alarm system.

Figure no. 1. View of electro-smog measuring instrument TES-92.

3.2. Thermo-hygrometer and barometer (atmosphere) PCE-THB 40

Metrological Factor Data Meter is the Thermo-Hygrometer and Barometer (atmosphere) PCE-THB 40 Temperature, relative humidity and atmospheric pressure from an SD memory card. PCE-THB 40 thermo hygrometer and barometer-atmosphere can measure ambient temperature, relative humidity, and atmospheric pressure, while keeping these results to an SD memory card. PCE-THB 40 thermo hygrometer and barometer-atmosphere is a compact data recorder with a large memory capacity (up to 16 GB of SD card)Spahiu and Kasemi, (2017).

Figure no. 2 Overview of the instrument Thermometer-hygrometer and barometer (atmosphere) PCE-THB 40

4. Results of the study

The measurements are carried out for each quarter in 2017 and 2018, on the basis of which we have made an average value for two places, at the entrance to the port and the most loaded with work. Measurements and results are also associated with the values of metrology factors in these areas based onSpahiu and Kasemi, (2017);(Metalla, et al, 2015) and (Wang et al. 2017).

Table No. 1. Metrological characteristics and electrical resistance marine facilities

Naval Port		January-March	April-June	July-September	October-December
Durrës	Relative humidity in air -HR (%)	51	53	48	56
	Temperature -T (0C)	11,2	20,1	23,8	16,7
	Barometric pressure-P (hPahPa)	1013,4	1012,5	1013,7	1015,2
	Electrical resistance	12,2-5,6	12,2-5,6	12,2-5,6	12,2-5,6
	K◎K◎/ M◎M◎	1,2-14,4	1,2-14,4	1,2-14,4	1,2-14,4
Vlorë	Relative humidity in air -HR (%)	46	42	44	48
	Temperature- T (0C)	10,4	19,5	23,4	16,4
	Barometric pressure-P (hPahPa)	1014,4	1013,5	1014,7	1016,2
	Electrical resistance	11,2-6,6			11,2-6,6
	K◎K◎/ M◎M◎ /(water/ earth,)	1,4-19,4			1,4-19,4
Sarandë	Relative humidity in air -HR (%)	48	39	44	52
	Temperature -T (0C)	17	25	28	16,5
	Barometric pressure -P (hPahPa)	1011,3	1015,4	1013,7	1012,5
	Electrical resistance	11,8-6,9			11,8-6,9
	K◎K◎/ M◎M◎ /(water/ earth,)	1,23-17,4			1,23-17,4
Shengjinë	Relative humidity in air -HR (%)	41	34	38	46
	Temperature -T (0C)	13	19	21	14
	Barometric pressure-P (hPahPa)	1011,7	1009,8	1010,7	1012,7
	Electrical resistance	10,2-6,6			10,2-6,6
	K◎K◎/ M◎M◎ /(water/ earth,)	1,5-19,4			1,5-19,4

Source: Own calculation's

Table No. 2. The level of electromagnetic pollution in the facilities of the Naval Port of Durrës (water / earth / air). (Measurements are at 50 m large machining distance)

The characteristics		The time of measurements			
		January-March	April-June	July-September	October-December
Density of magnetic flux(B)	Water	213	284	273	222
	Earth	243	214	223	252
$\left[\frac{W}{m^2}\right]\left[\frac{W}{m^2}\right]$	Air	343	234	263	352
Magnetic field strength (H)	Water	3462	5667	6123	5133
	Earth	6567	5442	7246	8183
$\left[\frac{W}{m^2}\right]\left[\frac{W}{m^2}\right]$	Air	5845	4987	6456	7321
Energy Density (S)	Water	234	435	352	213
	Earth	190	170	190	550
$\left[\frac{W}{m^2}\right]\left[\frac{W}{m^2}\right]$	Air	467	387	446	483
Electric field strength (E)	Water	2871	5677	7975	3589
	Earth	9698	8675	8978	9582
$\left[\frac{V}{m}\right]\left[\frac{V}{m}\right]$	Air	9698	9675	8978	9582

Source: Own calculation's

Table No. 3. The level of electromagnetic pollution in the facilities of the Naval Port of Vlorës (water / earth / air). (Measurements are at 50 m large machining distance).

The characteristics		The time of measurements			
		January-March	April-June	July-September	October-December
Density of magnetic flux	Water	198	213	197	199
	Earth	234	233	253	282
(B) $\left[\frac{W}{m^2}\right]\left[\frac{W}{m^2}\right]$	Air	298	312	298	333
Magnetic field strength	Water	2452	4567	5523	4533
	Earth	4567	3442	5246	6183
(H) $\left[\frac{W}{m^2}\right]\left[\frac{W}{m^2}\right]$	Air	4843	3987	5356	54321
Energy Density (S)	Water	194	358	332	313
	Earth	197	212	231	670
. $\left[\frac{W}{m^2}\right]\left[\frac{W}{m^2}\right]$	Air	367	487	346	383
	Water	1781	2656	6675	4554

Electric field strength (E) $\left[\frac{V}{m}\right]\left[\frac{V}{m}\right]$	Earth	8698	7634	7478	6556
	Air	6698	6642	6839	6554

Source: Own calculation's

Table No. 4 The level of electromagnetic pollution in the facilities of the Naval Port of Sarandës (water / earth / air). (Measurements are at 50 m large machining distance).

The characteristics		The time of measurements			
		January-March	April-June	July-September	October-December
Density of magnetic flux(B) $\left[\frac{W}{m^2}\right]\left[\frac{W}{m^2}\right]$	Water	213	284	273	222
	Earth	243	214	223	252
	Air	343	234	263	352
Magnetic field strength (H) $\left[\frac{W}{m^2}\right]\left[\frac{W}{m^2}\right]$	Water	3462	5667	6123	5133
	Earth	6567	5442	7246	8183
	Air	5845	4987	6456	7321
Energy Density (S) $\left[\frac{W}{m^2}\right]\left[\frac{W}{m^2}\right]$	Water	134	235	352	313
	Earth	145	271	198	650
	Air	367	334	246	583
Electric field strength (E) . $\left[\frac{V}{m}\right]\left[\frac{V}{m}\right]$	Water	1361	1677	1975	1589
	Earth	2666	2575	3865	2582
	Air	2222	2345	3734	2543

Source: Own calculation's

Table No. 5. The level of electromagnetic pollution in the facilities of the Naval Port of Shëngjin (water / earth / air). (Measurements are at 50 m large machining distance).

The characteristics		The time of measurements			
		January-March	April-June	July-September	October-December
Density of magnetic flux(B) $\left[\frac{W}{m^2}\right]\left[\frac{W}{m^2}\right]$	Water	213	284	273	222
	Earth	243	214	223	252
	Air	343	234	263	352
Magnetic field strength (H) $\left[\frac{W}{m^2}\right]\left[\frac{W}{m^2}\right]$	Water	3462	5667	6123	5133
	Earth	6567	5442	7246	8183
	Air	5845	4987	6456	7321

Energy Density (S) . $\left[\frac{W}{m^2}\right]\left[\frac{W}{m^2}\right]$	Water	234	435	352	213
	Earth	190	170	190	550
	Air	467	387	446	483
Electric field strength (E) . $\left[\frac{V}{m}\right]\left[\frac{V}{m}\right]$	Water	2871	5677	7975	3589
	Earth	9698	8675	8978	9582
	Air	9698	9675	8978	9582

Source: Own calculation's

In the following we will make some descriptions on the results achieved and descriptions of risk in this specific area.Referring to the obtained and elaborated results, the level of pollution from the eddy current comes clearly from:

- Electrical power of machinery installed in the port facilities, where for the largest values aremarked at Marine Port of Durres.
- The presence of electrical faults at different points as a result of the deterioration of the meteorological parameters of the September to March seasons, where the Marine Port of Durres and the Marine Port of Saranda are differentiate because of the geographical position.
- Values of atmospheric factors (temperature, atmospheric pressure, tumults, humidity), salinity content, and others.
- Magnetic and electrical environmental characteristics (materials).

Thus, the changes in the values of the characteristics of the electromagneticfield are related to the changes in the humidity content of the air and soil abrasions which depend on the atmospheric pressure, temperature and characteristics of the sea and other waves.

Conclusions

The study object, the results obtained from the meteorological factors monitoring, the measurements made on the characteristics of the electromagnetic fields in the port facilities give a clear picture of the eddy current pollution in these environments. According to this study, the level of pollution from the eddy currents depends not only on the installed electric power and the presence of possible technical defects but also depends on the content of the absolute humidity, temperature and atmospheric pressure in these environments. Factors that depend on the position of the shore, the protection system from the eras and the waves, the weather, etc.The metrological factors play a decisive role in the environment's impact on its conductivity, the environments directly reflect on the parameters of the magnetic and electron field surrounding these environments.

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