



Harbour water pollution study

Mounia El Haji

► To cite this version:

Mounia El Haji. Harbour water pollution study. CFM 2011 - 20ème Congrès Français de Mécanique, Aug 2011, Besançon, France. <hal-03421321>

HAL Id: hal-03421321

<https://hal.science/hal-03421321v1>

Submitted on 9 Nov 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



HAL Authorization

Harbour water pollution study

M. EL HAJT^a

*a. Department of Biology, Chemistry and Geology, Sidi Mohamed Ben Abdallah University,
Polydisciplinary Faculty of Taza, P.O. Box 1223, Taza-Gare, Morocco :*

Abstract :

Generally we observe that the water in the natural environment, in seaport or harbour, present the mineral content of organic matter allowing bacterial proliferation. The presence of mineral ion, nitrogen, phosphorus, sulfur, iron, manganese, calcium in the form of nitrate, phosphates, sulfates brought the necessary element for the growth of those micro-organism analysis.

After the interpretation of physical-chemical properties of, water of the harbour, it is sure that this environment favoured necessary conditions for the development of SRB associated to the other micro-organisms like the ferrous bacteria, that accelerated the bacteria corrosion process at the interface water-sediment in the basin.

All this data are highlighted by using software which allowed the visualization of these phenomena and to understand their evolution in the long-term. This tool moreover allows the preventive management of environments which are characterized by a large complexity about bacterial and physical-chemical levels.

Keywords: Water, Pollution, physical-chemical, SBR, harbour.

1 Introduction

Based upon the results of a physicochemical and bacteriological analysis, software has been devised to help define and exploit the changing trends of the long term transfer of pollutants in isolated harbours on one hand, and pinpoint the nature of corrosion affecting installations submerged in brackish environments, on the other hand.

The approach will lead the acquisition of useful tools to ensure a proper management of seaport infrastructures and carry out extrapolations between seaports with common characteristics.

2 Presentation of the Study area

Havre Seaport activity is carried out in three types of harbours [1]; [2] and [3] :

Tidal basins, under tide impact;

Wet docks whose level remains more or less unchanged, isolated from the above basins by sluice-gates or lock-chambers;

Constant level basins, where water level is unchanged.

The study deals with the analysis of the harbour water physicochemical parameters, exploited parameter-by-parameter basis, relying on a database in use at Havre Seaport since 1977. Regular samplings have been conducted on a monthly basis at the level of 11 points in Havre Seaport area and its industrial area extending over 5x30 km on the right bank of Seine estuary [4].

A linkage of the physicochemical processes and the bacteriological phenomena was conducted in order to pinpoint the interactions and especially the impact of accumulated organic matter in the sulphate-reducing bacteria proliferation [5] and [6].

The bacteria count [7] in harbours has led to the appreciation of the major role played by these micro-organisms in accelerated corrosion of seaport installations [8] and [9]. Based on the measures obtained, this work aims mainly at a detailed analysis of the physicochemical and bacteriological data.

3 Extrapolation Method

The outlines of the various harbours (non-nil depth zone limits) have been deduced thanks to the Havre Seaport map digitising. A rectangular rack covering the outlined area helped construct unstructured and adapted grid (relatively fine for zones of more measurement points) for all seaport harbours.

The interpolation phase consists in the redistribution of concentrations deduced from measurements (measurement scatter plot) on the grid nodes. The interpolation criterion is based on the distances between the measurement points and the grid nodes (the closer to the grid point a measurement point is, the greater becomes its contribution to the grid point in terms of concentration). This method is based upon the approaches applied in grid particle methods used in digital fluid mechanics which make it possible to go from a runoff as represented by a randomly distributed fluid particle scatter plot (Lagrangian description) to a given grid representation (Eulerian description). The linkage of these post-treatment modules has helped devise a software specifically for the overall representation and viewing of the transfer of pollutants in port zones. For Havre Seaport, in particular, the port sluice-gates and lock-chambers are taken into account, along with the depth of every harbour (the algorithm used in this study is summed up according to the procedure described in diagrams of figures. 1, 2, 3, 4 and 5).

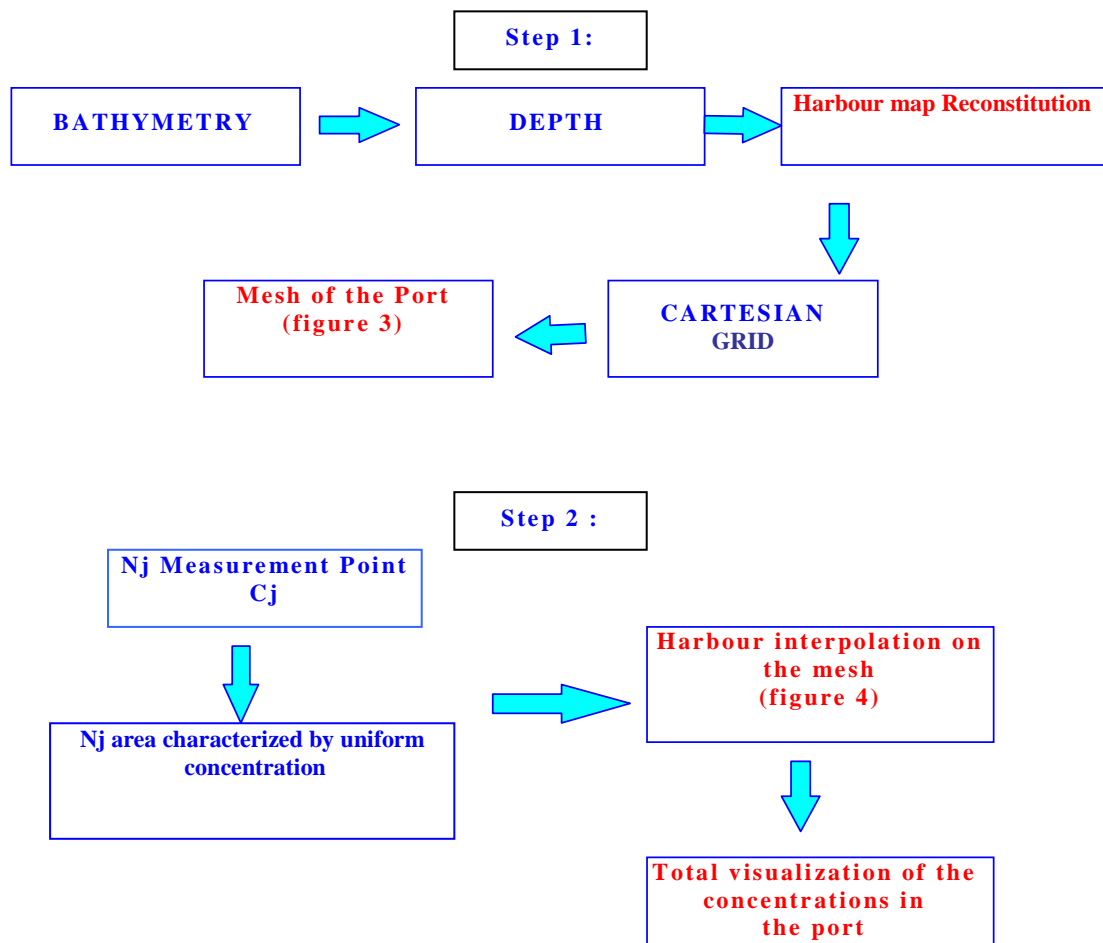


FIG. 1 – : Harbour grid

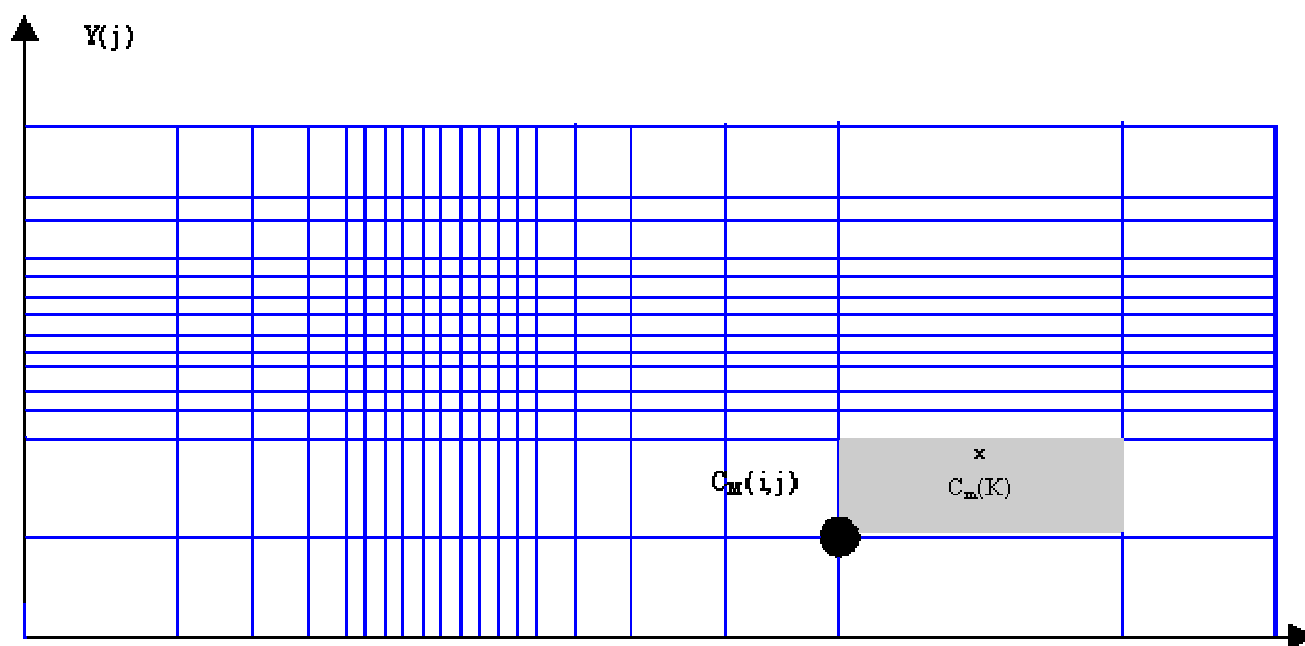


FIG. 2 – : Generation of (non-regular) rectangular grid covering the unit

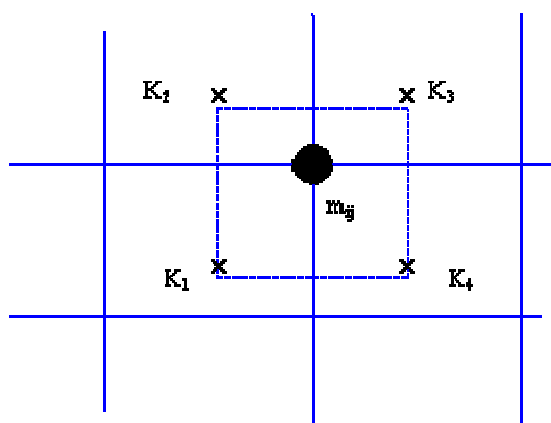
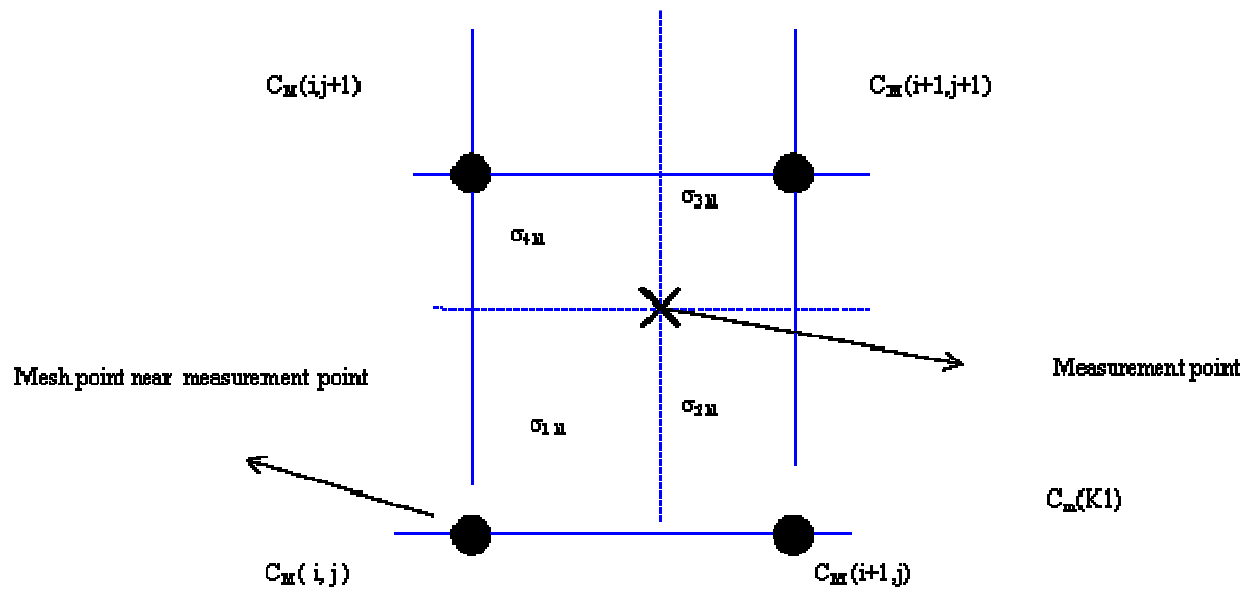


FIG. 3 – : Diagram of the interpolation of measurements on the grid based on the distances between the measurement points and the grid points



$$C_M(i, j) = \sum_{k,l} \frac{\sigma_{3kl}}{\sigma_T(k,l)} C_m(k,l)$$

σ_{lk} : Elementary surfaces ($l=1,4$)

σ_T : Total surface of the grid considered

FIG. 4 – : Diagram of the interpolation of measurements on the grid : Detail of the method used

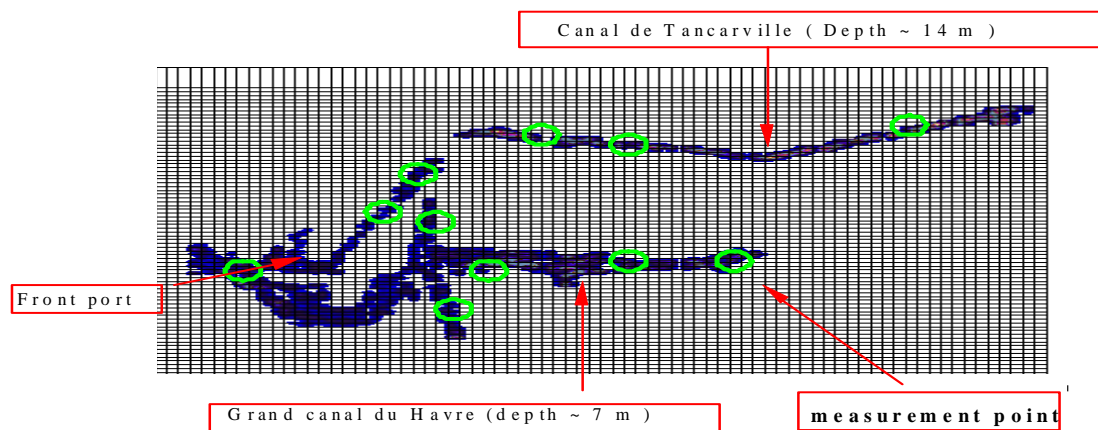


FIG. 5 – : Port plan deduced from the depth interpolation. Positions of the intake points

The behaviour of every parameter in the industrial zone is visualized using the software. The evolution of the main parameters traced by this study are the following: micro-organisms, iron, kjeldahl nitrogen and hydrocarbons (figures. 6, 7, 8 and 9). However, the port harbours have different depths and the parameters measured are realized on the basis of intakes from positions always situated at 1.5 m from the water surface.

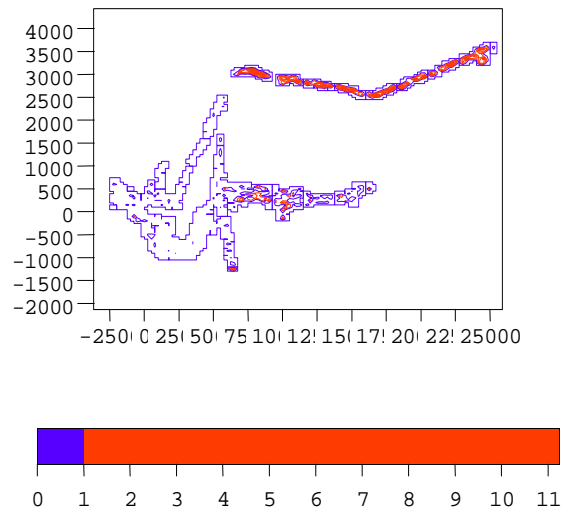


FIG. 6 – : Bacteria evolution

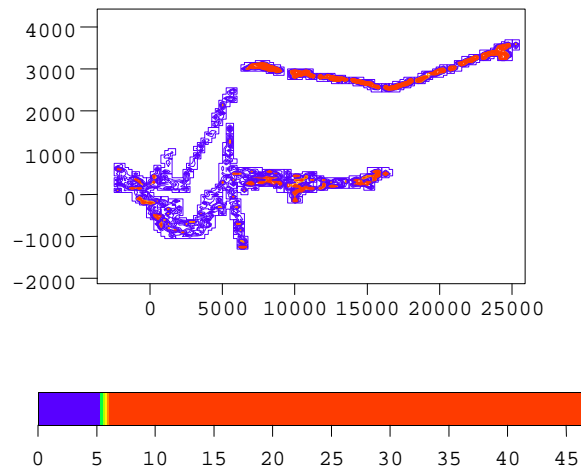


FIG. 7 – : Iron evolution (µg/l)

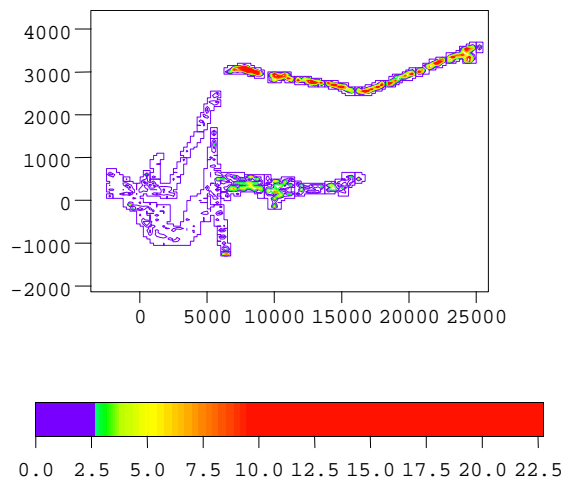
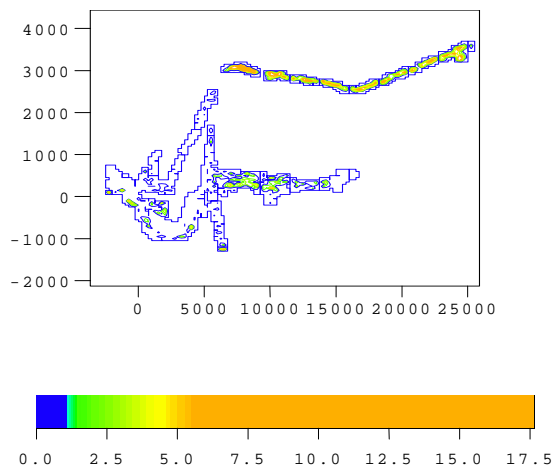


FIG. 8 – : NTK evolution(mg/l)

FIG. 9 – : Hydrocarbons evolution ($\mu\text{g/l CH}_2$)

The analysis leads to the conclusion that Tancarville channel is richer in nutritive elements. This is further confirmed by micro-organism proliferation in the harbour. Iron is present in all harbours, almost at constant quantities.

4 Conclusion

In the port zones where seawater is more or less polluted with industrial waste or urban effluents, the presence of micro-organisms has an undeniable impact on bacteria-induced corruptions [10]. Organic matter input [11] allows the development of anaerobic bacteria which could change sediment oxygenation conditions and, as a consequence, favour bacteria-induced corruptions [12] and [13].

The results of the post-treatment of tests and viewings deduced lead to the conclusion that Havre Seaport is affected by a particular case of bacteria-induced accelerated corrosion displayed in zones with high organic matter content.

Corrosion has, to a great extent, an impact on the resistance, endurance and security of metal structures. Anti-corrosion preventive measures should be taken when the installations are being designed. In view of the complex nature of corrosion, calling for a multidisciplinary approach (chemistry, biology, mechanics ...) [14] and [16], all factors and parameters involved should be fully understood and clear-cut criteria for the zone condition should be devised.

In view of the means made available at Havre Seaport for the follow-up of the quality of the harbour water, it would be desirable to conduct finer controls at various heights, or at least to conduct such controls on the basis of a common reference [16] and [17], with an altitude reference defined as starting from the harbour bed, for example.

References

- [1] Breton G. 1981. Observations sur l'écologie et les peuplements des bassins du port du Havre (France). Bull. Trim. Soc. Géol. Norm. et Amis du Museum du Havre, 46-55.
- [2] Chantereau J. 1977. Corrosion bactérienne–bactéries de la corrosion. Technique et documentation, 246 p.
- [3] Tatnall R.E. 1981. Fundamentals of bacteria induced corrosion. Mat. Perf. 20 (9): 32-38.
- [4] Rodier J, 1984. L'analyse de l'eau, eaux naturelles, eaux résiduaires et eaux de mer: physico-chimie, bactériologie, biologie. Edition Dunod, Paris, 1383 p.
- [5] Hamilton W A. 1985. Sulfate-reducing bacteria and anaerobic corrosion. Ann. Rev. Microbiol. 39, 195-217.
- [6] Sand W. 1987. Importance of hydrogen sulfide, thiosulfate and methylmercaptan for growth of thiobacilli during simulation of concrete corrosion. Appl. Environ. Microbiol., 53, 1645-1648.
- [7] Postgate J R. 1982. Economic importance of sulphur bacteria. Phil. Trans. R. Soc. Lond. B 298, 583-600.
- [8] Berner R A, Westrich J T. 1985. Bioturbation and the early diagenesis of carbon and sulphur, Am. Journ. Sci., 285, 193- 206.
- [9] Bryant R D, Jansen W, Boivin J, Laishley E J, Costerton J W. 1991. Affect of hydrogenas and mixed sulfate-reducing bacterial populations of the corrosion of steel. Appl. Environ. Microbiol. 57, 2804-2809.
- [10] Schalschl E. 1980. Elemental sulfur as a corrodent in deaerated, neutral aqueous solutions. Mat. Perf. 19, 9-12.
- [11] El Haji M, Louis C. 1998. Les rejets industriels dans la zone portuaire du Havre. Déchets sciences & techniques. N° 11 - 3^{ème} trimestre, 48, 39-44. N° de commission paritaire : 76929 - N° ISBN : 0753-3454. Dépôt légal 782.
- [12] Goldhaber M B, Kaplan I R. 1980. Mechanism of sulfure incorporation and isotope fractionation during early diagenesis in sediments of the Gulf of California. Mar. Chem., 383-104.
- [13] Von Wolgozen Kühr C A H, Van der Vlugt L S. 1934. The graphitization of cast iron as electrobiochemical process in anaerobic soils. Wat., Den Haag. 16, 147-165.
- [14] Neria-González I, Tao Wang E, Ramírez F, Romero J M, Hernández-Rodríguez C. June 2006,. Characterization of bacterial community associated to biofilms of corroded oil pipelines from the southeast of Mexico. Anaerobe, Volume 12, Issue 3, 122-133 p.
- [15] Luptakova A, Macingova E, Slesarova A, Ubaldini S, Abbruzzese C. Solubilization and immobilization of toxic metals by bacteria (Slovak Republic and Italy). IMWA Symposium 2007: Water in Mining Environments, R. Cidu & F. Frau (Eds), 27th - 31st May 2007, Cagliari, Italy. 3p.
- [17] Duque Z, Chicote E, Sarro M I. 2004. Corrosivity of H₂S-producing bacteria isolated from formation waters used in secondary crude-oil recovery. Rev. Téc. Ing. Univ. Zulia, ago. vol.27, no.2, 83-92. ISSN 0254-0770.
- [16] Lengke M F, Southam G. 2006. Bioaccumulation of gold by sulfate-reducing bacteria cultured in the presence of gold(I)- thiosulfate complex, Geochim Cosmochim Acta, 70:3646-3661.