

(RESEARCH ARTICLE)



Study of dissolve oxygen, salinity and temperature around western Offshore: A case study around ONGC'S offshore Filed (HRA & NLM platform), Arabian Sea, India

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GSC Advanced Engineering and Technology, 2022, 03(01), 044–051

Publication history: Received on 09 February 2022; revised on 11 March 2022; accepted on 13 March 2022

Article DOI: <https://doi.org/10.30574/gsaet.2022.3.1.0030>

Abstract

Marine ecosystems cover approximately 71% of the Earth's surface and contain approximately 97% of the planet's water. Dissolve oxygen, which is a vital parameter in Ocean's primary production, is having a sensitive integrating property reflecting physical and biogeochemical changes in the marine environment. The dissolve oxygen in the sea water is affected by parameters such as high organic load, high temperature and high salinity level. The higher the oil pollution load, less will be the dissolved oxygen concentration level. The solubility of oxygen decrease as temperature increases. Dissolved oxygen decreases exponentially as salt levels increase. Thus temperature and salinity have a great impact upon biological productivity and are important to understand the dynamics of water column. Nearly all living organisms need oxygen in order to carry out their biological processes. By analyzing the variation of dissolve oxygen, temperature and salinity, environmental status of that particular study area can be assessed. As a preventive measure to protect water bodies, Oil and Natural Gas Corporation Limited, India is regularly conducting Offshore Environment Monitoring around western continental shelf of Arabian Sea, where ONGC's Platforms and Installations are located.

An attempt has been made for assessment of marine environment around ONGC's offshore Filed (HRA & NLM platform), Arabian Sea by the study of dissolve oxygen, salinity and Temperature etc. The paper includes the output of monitoring activities of ONGC considering three parameters i.e. temperature, salinity and dissolved oxygen for assessing the environmental health of the study area. The study of the three parameters ONGC's offshore Filed (HRA & NLM platform) has been done considering the monitoring data for the year 2020-21 and their variation has been studied with the values of Reference location (situated at 10 km from the installation). It has been observed from the study that there is no significant changes in the mean values of three parameters compared to the reference mean values. This clearly establishes that the oil production activities at HRA & NLM platform is not affecting the dissolve oxygen level around the installation.

Keywords: Dissolve Oxygen (DO); Temperature; Salinity; Arabian Sea; ONGC

1. Introduction

Dissolved oxygen concentration is affected by physical, chemical and biological processes. Factors which cause an increase in dissolved oxygen concentration are photosynthesis, diffusion from the sea surface, and mainly the action of the wind and the currents which by causing surface water turbulence, saturate the surface layers with oxygen. Reduction of dissolved oxygen concentration is caused by the respiration of marine organisms and by the oxidation of organic substances either by simple chemical reactions or by bacterial activity. High temperatures and high salinity values lead to a reduction in oxygen solubility.

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Nearly all living organisms need oxygen in order to carry out their biological processes. However, the quantity of oxygen demanded differs according to species, mode of life, sex, age as well as environmental factors such as temperature, salinity and the presence of various types of pollutants.

After discovery of Bombay High in 1974, ONGC has deployed several drilling rigs and commissioned process platforms besides more than a hundred unmanned platforms in Western continental shelf. As per its own self control strategies and commitment to protect marine environment, ONGC started regular environment monitoring of its oil fields and installations around Western Offshore areas. IPSHEM, a pioneer institute of ONGC to take care of the Safety, Health and Environmental needs of the petroleum sector, is carrying out the monitoring job of the important environmental parameters since 1994-95.

2. Material and methods

2.1. Study Area

The study area is covering around ONGC's offshore field (HRA & NLM platform) in the Western continental shelf is shown as below.



Samples were collected according to OSPAR guideline (Fig. 2), 18 sampling stations were fixed around each installation at circle of radius from 250 m to 4000 m from the center of installation. Reference point was fixed approximately 10 km away from installation point.

2.3. Sample analysis

Parameters like temperature, salinity, dissolved oxygen are determined, onboard the vessel, using the CTD profiler and the values were double-checked using manual methods.

2.3.1. Dissolve Oxygen

Dissolved Oxygen (DO) was measured directly by SYSTRONICS water analyser with an accuracy of 0.1 ppm. The values of DO are expressed in mg/l.

2.3.2. Temperature

Temperature was measured using the centigrade thermometer with a graduation of 0 - 100 °C. This is an important parameter since the characteristics of water column like the density, viscosity, solubility, of gases and dissolved oxygen are related to temperature of the water column. The variation in temperature of a water body has great impact upon the biological productivity. The organism including fishes show limited tolerance for variation in temperature for processes such as feeding, reproduction and movement. Distribution of aquatic organism is greatly influenced by water temperature.

During the survey it was revealed that the water column experienced homogeneous and uniform distribution of temperature indicating that the impact of the offshore operation on the thermal regime of the water column is insignificant.

2.3.3. Salinity

Salinity was measured directly by SYSTRONICS water analyzer with an accuracy of 0.1ppt. Prior to the sample, standard seawater was used to calibrate the salinometer.

3. Results and discussion

3.1. Dissolved Oxygen (DO)

Dissolved oxygen is one of the essential and very important parameters in assessing the health of aquatic environment. Mean value for DO around HRA & NLM platform are 6.08 mg/l and 6.03 mg/l respectively (Fig.3 & Table.1-2). Reference values of both platform are comparable with mean DO values (Fig.3 & Table.1-2).

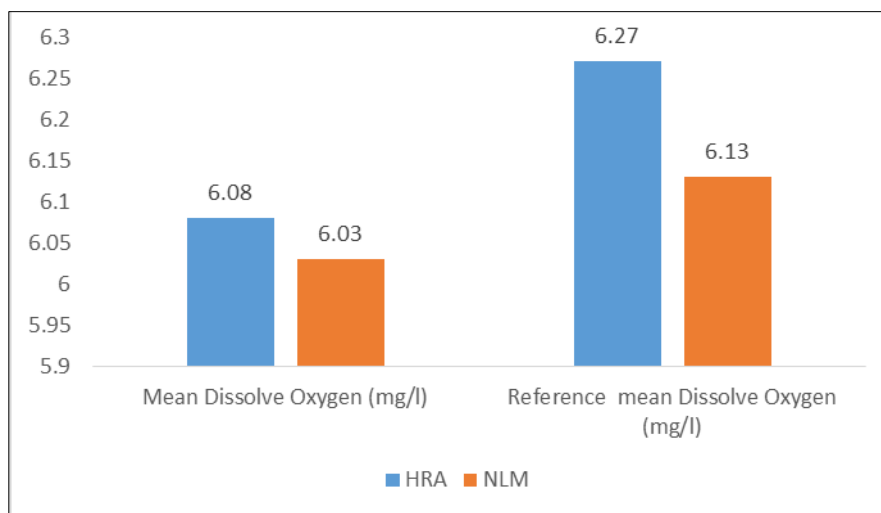


Figure 3 Dissolve oxygen (mg\l) during 2020-21

3.2. Temperature

The mean sea temperature around HRA platform is 27.24 °C whereas for NLM platform is 26.69 °C during the period of 2020-21. It has been observed that that reference values are comparable with mean values (Fig.4 & Table.1-2).

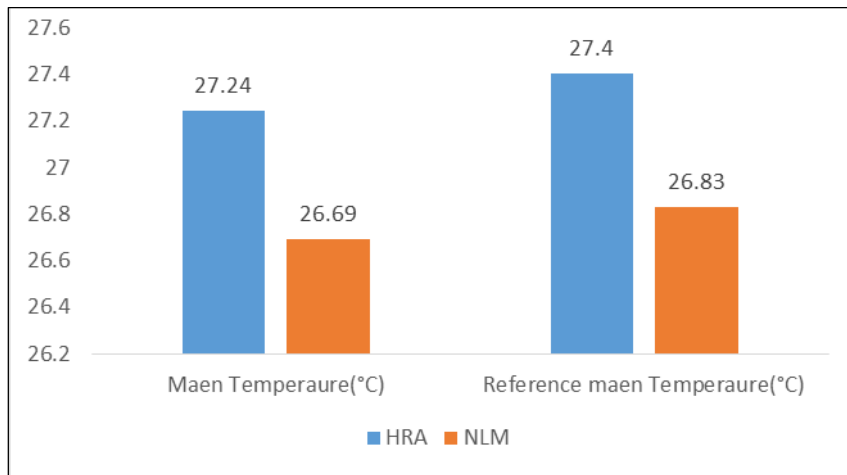


Figure 4 Temperature (°C) during 2020-21

3.3. Salinity

Around HRA and NLM platforms mean salinity values are 36.53 PSU and 36.66 PSU respectively (Fig.5 & Table.1-2) for 2020-21. It has been observed that mean salinity values almost comparable with reference values (Fig.5 & Table.1-2).

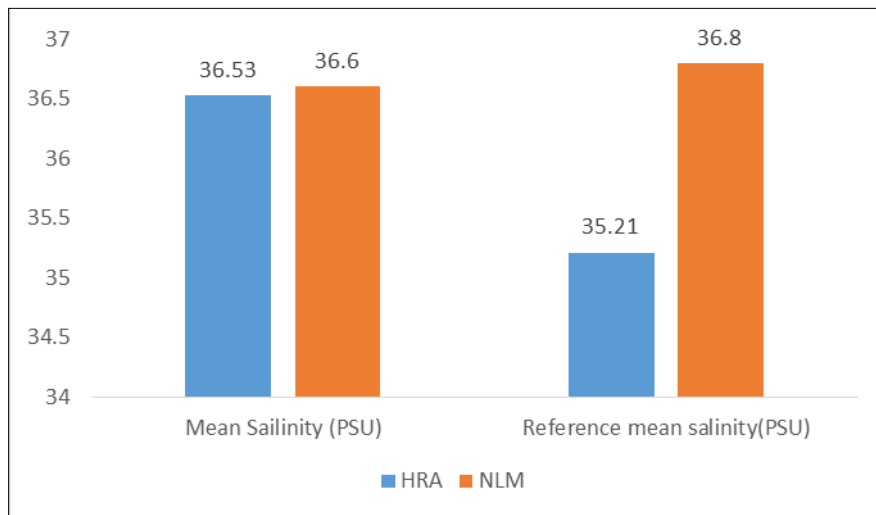


Figure 5 Salinity (PSU) during 2020-21

4. Conclusion

The paper includes the output of monitoring activities of ONGC considering variation of these three environmental parameters for assessing the influence of E&P activities on marine environment. It has shown that the values are comparable with reference values and almost remain constant throughout year around ONGC installation. It has been observed from the study that values of these parameters are almost equal to the values of the reference point situated at a distance of 10 km from the installation. Since, there is no decrease in dissolve oxygen and increase in salinity and Temperature around HRA and NLM it is concluded that oil production activities carried out at the installations are not causing any adverse environmental impact.

Compliance with ethical standards

Acknowledgments

The authors are grateful to the ONGC's management for encouraging for preparation and presentation of this paper. They also wish to acknowledge ED-HoI, IPSHEM for his continuous guidance and support.

Disclosure of conflict of interest

The authors declare no conflict of interest.

References

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- [2] Offshore Environment Monitoring around ONGC installations in Western Offshore Region reports 2020-21.
- [3] Marine pollution bulletins.

Supporting Table

- Installation: Heera
- Coordinates: 18°34'37.20"N 72°14'27.00"E
- Date of Sampling: 01st January, 2021
- Time of Sampling: 8.10 -11.20 hrs

Sampling Station	Distance from the installation In meter	Sampling Depth	Dissolved oxygen in mg/l	Temp °C	Salinity (PSU)
HRA-1	250 m E	Surface	6.0	27.3	37.74
		Middle	6.4	26.8	37.49
		Bottom	6.2	28.3	37.24
HRA -2	500 m E	Surface	6.2	26.9	36.45
		Middle	6.0	27.3	35.78
		Bottom	5.9	26.3	36.41
HRA-3	1000 m E	Surface	6.6	27.4	35.89
		Middle	6.0	26.7	36.74
		Bottom	5.9	26.0	35.89
HRA-4	2000 m E	Surface	6.0	26.2	36.74
		Middle	5.4	27.3	37.21
		Bottom	5.8	27.1	36.25
HRA -5	250 m N	Surface	6.3	26.9	36.87
		Middle	6.0	28.2	37.52
		Bottom	5.9	28.6	36.01
HRA-6	500 m N	Surface	6.2	27.6	37.62
		Middle	5.9	27.3	36.85

		Bottom	6.2	26.8	37.54
HRA-7	1000 m N	Surface	5.9	25.3	36.98
		Middle	6.4	27.1	35.87
		Bottom	6.3	28.2	36.12
HRA -8	2000 m N	Surface	6.0	26.3	37.28
		Middle	5.9	27.4	36.51
		Bottom	5.4	28.5	36.27
HRA-9	4000 m N	Surface	5.9	26.8	37.51
		Middle	6.1	26.9	36.64
		Bottom	6.4	28.0	37.84
HRA-10	10000 m N	Surface	6.8	27.9	36.98
		Middle	6.1	26.7	34.52
		Bottom	5.9	27.6	34.12
HRA -11	250 m W	Surface	6.8	26.8	35.62
		Middle	6.4	27.6	37.54
		Bottom	5.9	26.8	36.85
HRA-12	500 m W	Surface	6.0	26.7	36.41
		Middle	6.3	27.4	34.95
		Bottom	5.8	27.6	36.89
HRA-13	1000 m W	Surface	6.2	27.3	37.51
		Middle	6.0	26.8	36.21
		Bottom	6.3	27.4	37.65
HRA -14	2000 m W	Surface	6.0	27.6	35.12
		Middle	5.7	26.9	35.98
		Bottom	5.9	28.3	36.12
HRA-15	250 m S	Surface	6.1	27.1	35.32
		Middle	5.8	28.5	35.21
		Bottom	6.1	26.7	36.19
HRA-16	500 m S	Surface	6.2	27.4	37.62
		Middle	5.9	27.3	36.85
		Bottom	5.7	28.0	36.33
HRA -17	1000 m S	Surface	6.0	27.6	37.65
		Middle	6.3	27.3	36.54
		Bottom	6.4	26.8	35.46
HRA-18	2000 m S	Surface	6.9	27.1	35.14
		Middle	6.4	27.3	34.36
		Bottom	6.0	27.6	36.22

- INSTALLATION : NLM
- Coordinates: 18°42'16.80"N 72°20'17.40"E
- Date of Sampling: 01st January, 2021
- Time of Sampling: 14.25 - 17.40 hrs

Sampling Station	Distance from the installation in meter	Sampling Depth	Dissolved oxygen (mg/l)	Temp. °C	Salinity (PSU)
HRA-1	250 m E	Surface	6.1	27.2	36.21
		Middle	6.0	27.1	37.45
		Bottom	6.0	26./	38.25
HRA -2	500 m E	Surface	5.8	27.4	36.85
		Middle	6.2	27.3	38.56
		Bottom	6.3	27.1	36.87
HRA-3	1000 m E	Surface	6.1	26.0	37.21
		Middle	5.8	26.8	37.52
		Bottom	5.9	26.3	36.54
HRA-4	2000 m E	Surface	6.1	26.4	38.21
		Middle	6.3	26.1	37.41
		Bottom	5.6	27.3	35.28
HRA -5	250 m N	Surface	6.0	27.5	36.52
		Middle	6.2	26.4	37.52
		Bottom	6.5	26.8	35.62
HRA-6	500 m N	Surface	6.3	26.4	35.87
		Middle	6.4	26.8	36.87
		Bottom	5.6	27.3	35.63
HRA-7	1000 m N	Surface	5.8	27.6	37.54
		Middle	5.4	26.9	37.54
		Bottom	6.2	27.0	35.63
HRA -8	2000 m N	Surface	6.6	26.1	36.44
		Middle	5.9	25.3	36.87
		Bottom	6.1	26.1	36.74
HRA-9	4000 m N	Surface	6.3	25.7	37.21
		Middle	5.8	26.4	35.74
		Bottom	6.1	27.3	35.87
HRA-10	10000 m N	Surface	6.3	27.6	36.54
		Middle	6.2	26.1	37.54
		Bottom	5.9	26.8	36.32
HRA -11	250 m W	Surface	5.6	27.0	36.54

		Middle	5.4	27.3	35.46
		Bottom	5.8	26.4	35.68
HRA-12	500 m W	Surface	6.3	27.1	36.71
		Middle	5.9	26.5	35.52
		Bottom	5.7	26.4	36.47
HRA-13	1000 m W	Surface	6.3	27.3	37.56
		Middle	6.6	27.6	36.87
		Bottom	6.2	26.8	37.54
HRA -14	2000 m W	Surface	6.5	26.3	35.21
		Middle	5.7	25.4	37.11
		Bottom	5.6	26.1	35.89
HRA-15	250 m S	Surface	6.0	26.8	36.01
		Middle	5.9	25.7	36.41
		Bottom	5.6	25.9	35.32
HRA-16	500 m S	Surface	6.0	26.0	35.21
		Middle	6.2	26.3	37.14
		Bottom	5.9	26.8	36.74
HRA -17	1000 m S	Surface	6.4	26.5	36.21
		Middle	6.2	27.1	36.43
		Bottom	5.9	27.6	37.04
HRA-18	2000 m S	Surface	6.1	26.5	37.23
		Middle	6.4	27.3	36.24
		Bottom	5.9	27.1	35.89