EFFECT OF PHYSICOCHEMICAL AND BIOLOGICAL PARAMETERS ON QUALITY OF WATER OF ABANDONED QUARRIES FROM NEWASA TAHSIL

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ABSTRACT: In the present investigation, physico-chemical and biological analyses of eight water bodies were done to know the seasonal variation in the algal communities with respect to changing physicochemical parameter of the water, conducting the status and monitoring of quarries water resources. The concentration of parameter ranged as: Temp.(23-26°C), pH(6-7.5), turbidity(3.8-48.1 NTU), Totalsolids (400-3200mg/L), freeCO₂(10.6-77 mg/L), DO(11.35 to 18.24 mg/L), chlorides(15.62 to 259.86 mg/L), hardness(74-520mg/L), Calcium(15.23-108.22mg/L), Mg(7.31-67.3mg/L). This water leads to the growth of various algae (macrophytes) like Chara, Nitella, Enteromorpha, Cadophora, along with this Microscopic forms like Chlymadomonas, Clastorium, Cosmarium, Scenedesmus, Blue green algae like Spirullina, Oscillatoria, Anebena and green form like Euglena and Pediastrum are the common algal forms occurring in this water bodies. The results suggested that water sample from site no.2 and 6 is not suitable for public consumption and agricultural purposes.

Keywords: Physico-chemical, algal diversity, quarries

1) INTRODUCTION

Quarrying is a form of surface mining used when the Rock is close to the surface of the land. For necessity of difference Rocks that huge place dugged and gap filled with water naturally coming from the heart of the land and some of the water of Rain, this homogeneous mixture different water resource collected in one dugged tank is called as quarries. Water from quarries used for public consumption and agricultural purposes.

In Newasa Tahsil, most of the quarries are abandoned and left as giant pit. Then they refill with water and become small lake or pond. Most of the quarries are considered to be unsafe, unstable, and unusable.

For the human and industrial growth, water is considered to be the main requirement. Increase in population and industrialization, the demand of the freshwater increases in the last decades. This demand is somehow fulfilled by the waters from quarries which provide the water for human life and agriculture purposes. Due to the waste discharged from the human and industrial activities, the quality of water has deteriorated which affects human as well as aquatic life. According to WHO, CPCB, BIS, ICMR, the water quality of about 70% water resources was contaminated due to pollutants in India and some of the water was too poor for human consumption (Ramakrishnaiah et al., 2009; Jindal and Sharma, 2010). Assessment of quality of water using various parameters (physico-chemical and biological) and the different ways and techniques to protect the river water have been reported in the literature (Santosh et al., 2008; Yisa and Jimoh, 2010; Shah et al., 2015).
2) STUDY METHODOLOGY

2.1 Study area

Location and Extent - Newasatehsil of Ahmednagar District lies between 19°14’ and 19°43’ N and 74°41’ and 75°13’ E with an area of 621 square miles. Newasa is situated to both sides the Ahmednagar and Aurangabad highway about 60 km north to Ahmednagar town.

Physiography - The general character of Newasa is a flat plain, sloping gently northwards towards the Godavari River. In the south and southeast the country has more decided slope upwards to Nagar range of hills. The drainage is wholly towards the Godavari which from the boundary of the tehsil on the north.

Climate - The climate is usually hot potential evapotranspiration (PET) is far excess of the precipitation and is classified on semi-arid tropical region. The tehsil experiences a hot spell from March to November and a cool season from December to February. The rainfall is scanty and annual precipitation is 535.4mm. The mean annual maximum and minimum temperature is 32.3°C and 17.0°C respectively.

Image: Map showing different selected sites for collection of sample.

2.2 Sampling Stations - The samples were collected from abandoned quarries of Newasa Tehsil. Eight sites were selected for the collection of sample which as follows –

Site 1- Saundala Site 2-Newasa
Site 1: It is located on the roadside of newasa-shevgaon. This quarry is so big. The sources of water are rain water and ground water.

Site 2: The site is located in between Newasa and Newasa phata, near the Dnyaneshwar College. At present this quarry is not in use. The rain is only one source of water. As there is no work there is abundance growth of chara.

Site 3, 4 and 5, 8 are located near each other at the distance of 200-250 m. These sites are located in between Ranjangaon and Saundala, it is 8 km away from newasa phata. The quarry is get filled with rain water. The water is get stored in the quarry for many days which is used by farmers for their needs or for agriculture purposes, for drinking of animals, due to storage of water the diversity of algae like chara, spirogyra etc. are noted in the quarry.

Site 6: The site is located on the side of pune Aurangabad highway in wadala village. This quarry is not in use which get filled with rain water and become a pond. The algal bloom is formed in the quarry.

Site 7: The site is located in the village Bhanashivre which is 4 km away from Newasa phata towards east. The water source of this quarry is only Rain water. There is abundant growth of algae Spirogyra in this water body.
3) MATERIAL AND METHODOLOGY ANALYSIS

3.1 Temperature - In an established system the water temperature controls the rate of all chemical reactions, and affects fish growth, reproduction and immunity. Drastic temperature changes can be fatal to fish.

3.2 Colour -

Even pure water is not colourless. It has got pale green-blue tint in large volumes. Colour in natural waters may occur due to the presence of acids, metallic ions such as iron and manganese, suspended matter, phytoplankton, weeds and industrial wastes etc. Colour due to organic acids may not be harmful as such, but highly coloured waters are objected on aesthetic grounds.

3.3. pH

pH (Electrometric method) The pH of water sample was measured by electronic portable pH meter. The pH meter was calibrated with phosphate buffer of known pH. It uses electrodes that are free from interference. At constant temperature, a pH change produces a corresponding change in the electrical property of the solution. This change was read by the electrode and the accuracy was the greatest in the middle pH ranges.

3.4 Turbidity

Turbidity is the cloudiness of water caused by a variety of particles and is another key parameter in drinking water analysis. It is also related to the content of diseases causing organisms in water, which may come from soil runoff. The turbidity is measured by Nephelometer.

3.5. Dissolved Oxygen (DO)

For the estimation of Dissolved Oxygen the water samples were collected with care in BOD bottles without bubble formation. The DO was then fixed at the station itself by adding 1 ml each of Manganese Sulphate (MnSO4) and Alkali-iodate azide (KI) reagents and brought to the laboratory. The precipitates formed were dissolved by adding 2 ml. of concentrated Sulphuric acid (H2SO4). 100ml sample was taken from this and titrated against 0.1N Sodium thiosulphate. Starch is used as an indicator to estimate iodine generated and the end point is noted as the solution turns from blue to colourless. The DO is calculated using following formula,

\[
\text{DO mg/l} = \frac{B.R. \times N \times 1000}{\text{Amount of sample taken}}
\]

Where, B. R. = Burette Reading (Amount of titrant used). N = Normality of Sodium thiosulphate.

3.6 Carbon Dioxide

Carbon dioxide is the end product of organic carbon degradation in almost all aquatic environments and its variation is often a measure of net ecosystem metabolism (Smith 1997, 1993, Hopkinson 1985). Therefore, in aquatic biogeochemical studies, it is desirable to Physico-chemical parameters for testing of water – A review Patil. P.N, Sawant. R.N International Journal of Environmental Sciences Volume 3 No.3, 2012 1197 measure parameters that define the carbon dioxide system. The method is based on the principle that free carbon dioxide (CO2) in water reacts with sodium hydroxide (NaOH) to form sodium bicarbonate (Na2CO3) and the end point is indicated by development of pink colour using phenolphthalein an indicator at pH 8.3. To estimate CO2 in water in 100 ml. sample 2 to 3 drops of phenolphthalein were added and the sample was titrated against 0.05N Sodium hydroxide until a pink colour was obtained. The free carbon dioxide was calculated using following formula:

\[
\text{Free CO}_2 \text{(mg/l)} = \frac{B.R. \times N \times 44 \times 1000}{\text{Amount of sample taken}}
\]

Where, B.R. = Burette Reading (Amount of titrant used). N = Normality of Sodium Hydroxide (0.05N). 44 = Equivalent weight of CO2.
3.7 Calcium

It is measured by complexometric titration with standard solution of ETDA using Patton’s and Reeder’s indicator under the pH conditions of more than 12.0. These conditions are achieved by adding a fixed volume of 4N Sodium Hydroxide. The volume of titre (EDTA solution) against the known volume of sample gives the concentration of calcium in the sample.

3.8 Magnesium

It is also measured by complexometric titration with standard solution of EDTA using Eriochrome black T as indicator under the buffer conditions of pH 10.0. The buffer solution is made from Ammonium Chloride and Ammonium Hydroxide. The solution resists the pH variations during titration.

3.9 Total Hardness

Total Hardness (EDTA Titrimetric Method, APHA, 1998) For the estimation of total hardness, in 100 ml. of sample, 1 to 2 ml of buffer solution and a pinch of Eriochrome Black-T (used as an indicator) were added. After the appearance of wine red colour, the mixture was titrated against EDTA stirring continuously till end point change of wine red to blue is achieved. The total hardness is calculated using following formula:

\[
\text{Total hardness (mg CaCO}_3/l) = \frac{A \times N \times 1000}{\text{Amount of sample taken}}
\]

Where \( A \) = ml of titrant (EDTA) used. \( N \) = Normality of EDTA.

3.10 Total Solids

Total solids is the term applied to the material residue left in the vessel after evaporation of the sample and its subsequent drying in an oven at a temperature of 103-105°C. Total solids include Total Suspended Solids (TSS) and Total Dissolved Solids (TDS). A known volume of the well-mixed sample (50ml) is measured into a pre-weighed dish and evaporated to dryness at 103°C on a steam bath. The evaporated sample is dried in an oven for about an hour at 103-105°C and cooled in a desiccator and recorded for constant weight.

\[
\text{Total solids (Mg/L)} = \frac{(W_1 - W_2) (1000)}{\text{Sample volume (ml)}}
\]

\( W_1 \) = Weight of dried residue + dish
\( W_2 \) = Weight of empty dish

Total Suspended Solids

Suspended solids are the portions of solids that are retained on a filter of standard specified size (generally 2.0 µ) under specific conditions. The known volume of vigorously shaken sample (50ml) is filtered into a pre-weighed glass fibre filter disk fitted to suction pump, and washed successively with distilled water. The filter is carefully removed from the filtration apparatus and dried for an hour at 103-105 °C in an oven, cooled in desiccator and weighed for constant weight.

\[
\text{Total Suspended Solids (mg/L)} = \frac{(W_1 - W_2) (1000)}{\text{Sample volume (ml)}}
\]

\( W_1 \) = Weight of dried glass fibre filter + residue
\( W_2 \) = Weight of glass fibre filter disk before filtering

Total Dissolved solids

Dissolved solids are solids that are in dissolved state in solution. Waters with high dissolved solids generally are of inferior palatability and may induce an unfavourable physiological reaction in the transient consumer. The difference in the weight of total solids and the total suspended solids expressed in the same units gives the total dissolved solids.
3.11 Chlorides

The presence of chlorides in natural waters can mainly be attributed to dissolution of salt deposits in the form of ions (Cl\(^-\)). Otherwise, high concentrations may indicate pollution by sewage, industrial wastes, intrusion of seawater or other saline water. It is the major form of inorganic anions in water for aquatic life. High chloride content has a deleterious effect on metallic pipes and structures, as well as agricultural plants. They are calculated by Argentometric method.

In alkaline or neutral solution, potassium chromate indicates the endpoint of the silver nitrate titration of chlorides. Silver chloride is quantitatively precipitated before the red silver chromate is formed.

A known volume of filtered sample (50ml) is taken in a conical flask, to which about 0.5ml of potassium chromate indicator is added and titrated against standard silver nitrate till silver dichromate (AgCrO\(_4\)) starts precipitating.

**Calculation:**

\[
\text{Chlorides (Cl\(^-\))} = \frac{(A-B) \times (N \times 35.45)}{\text{Sample taken in ml}}
\]

Where,
A - Volume of silver nitrate consumed by the sample
B - Volume of silver nitrate consumed by the blank
N - Normality of silver nitrate (Standard methods, APHA, 16th edn, pp 286-88)

4) RESULT AND DISCUSSIONS

4.1 Physicochemical analysis

The present study deals with Physico - Chemical and Biological analysis of water from eight quarries of Newasa Tehsil. Since this quarries are abandoned, large quantity of water is been collected in such quarries during rainy season or some of the quarries having springs as a source of water. This water leads to the growth of various algae (macrophytes) like *Chara, Nitella, Enteromorpha, Cadophora*, along with this Microscopic forms like *Chlymadomonas, Clastorium, Cosmarium, Scenedesmus*, Blue green algae like *Spirullina, Oscillatoria, Anbeena* and green form like *Euglena* and *Pediastrum* are the common algal forms occurring in this water bodies. The quarries selected for the present work are mostly meant for stone purposes only, which are blasted by land mines, from the 8 selected sites 3 quarries are permanently abandoned while five of them are temporarily abandoned once. Taking this factor into account the study is plan to know the temporary and permanent algal forms present in those quarries, also to know the seasonal variation in the Phytoplankton communities with respect to changing Physico chemical parameter of the water. The temperature recorded in the month of February and March ranges from 23\(^\circ\) to 26\(^\circ\) C, which changes according to the season. Colour of the water in the studied quarries was visually observed.

Site no. 1, 3, 5, 7 and 8 sites shows colourless water while Site 2, 4, shows yellow light green colour and Site No. 6 shows green water colour. This clearly indicates the present of different algae in those water bodies. The Phytoplankton data of 2 and 4 No. quarries shows dominance of diatoms, while sampling site no. 6 shows present of green and blue green algae. (*Spirullina, Oscillatoria, Glocapsa*). The turbidity values ranges from 3.8 to 48.1 NTU. This values are also fluctuating, the highest amount of turbidity occurs in sampling Site No. 7 where there is continuous stone quarrying process while the lowest value recorded in the Site No. 2, 3, 5 were the quarrying activity is stopped.

The pH of the water ranges from 6 to 7.5. The lowest value recorded in the quarry no. 4 while the highest pH i.e. 7.5 is observed in quarry no. 1. These values are acidic to neutral or slightly higher than the neutral. Total solids, total dissolved solids, total suspended solids level is found to be varying. The total dissolved solids are maximum in quarry no. 6 i.e. 2200 mg/l where the the quarrir is also shallow, most of the water body is full of green and blue green algae, also the total suspended sloids in this quarry is highest than any other sampling sites.
The amount of total suspended solid is very less in quarry no. 1 where the source of water is spring water and comparatively very less and no growth of Phytoplanktons. The amount of free CO2 and dissolved Oxygen fluctuates from 10.6 to 77 mg/l and 11.35 to 18.24 mg/l respectively.

The highest amount of dissolved Oxygen is recorded in Site No. 6 where water is shallow and large amount of algal growth is observed. The chloride content ranges from 15.62 to 259.86 mg/l. The highest level of chloride was observed in Site No. 2 where there is a maximum disturbance by human activity and cattle is observed.

<table>
<thead>
<tr>
<th>Sample No</th>
<th>Sample 1</th>
<th>Sample 2</th>
<th>Sample 3</th>
<th>Sample 4</th>
<th>Sample 5</th>
<th>Sample 6</th>
<th>Sample 7</th>
<th>Sample 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp. °C</td>
<td>23</td>
<td>25</td>
<td>24</td>
<td>26</td>
<td>26</td>
<td>25</td>
<td>26</td>
<td>25</td>
</tr>
<tr>
<td>Colour</td>
<td>Colour less</td>
<td>Light Yellow</td>
<td>Colour less</td>
<td>Light green</td>
<td>Colour less</td>
<td>Green</td>
<td>Colour less</td>
<td>Colour less</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>3.8</td>
<td>25.1</td>
<td>6.3</td>
<td>16.9</td>
<td>30.2</td>
<td>39.2</td>
<td>48.1</td>
<td>12.8</td>
</tr>
<tr>
<td>pH</td>
<td>7.5</td>
<td>6.8</td>
<td>7.5</td>
<td>6</td>
<td>7.1</td>
<td>7.1</td>
<td>6.2</td>
<td>6.3</td>
</tr>
<tr>
<td>T.S. (mg/l)</td>
<td>700</td>
<td>1200</td>
<td>600</td>
<td>600</td>
<td>400</td>
<td>3200</td>
<td>400</td>
<td>800</td>
</tr>
<tr>
<td>T.D.S. (mg/l)</td>
<td>500</td>
<td>800</td>
<td>400</td>
<td>200</td>
<td>100</td>
<td>2200</td>
<td>100</td>
<td>500</td>
</tr>
<tr>
<td>T.S.S. (mg/l)</td>
<td>200</td>
<td>400</td>
<td>200</td>
<td>400</td>
<td>300</td>
<td>1000</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Free CO2 (mg/l)</td>
<td>11.44</td>
<td>15.84</td>
<td>10.56</td>
<td>19.36</td>
<td>10.56</td>
<td>77</td>
<td>30.08</td>
<td>45.01</td>
</tr>
<tr>
<td>Cl (mg/l)</td>
<td>232.88</td>
<td>259.86</td>
<td>39.76</td>
<td>49.70</td>
<td>56.80</td>
<td>15.62</td>
<td>32.66</td>
<td>53.96</td>
</tr>
<tr>
<td>Hardness (mg/l)</td>
<td>480</td>
<td>380</td>
<td>94</td>
<td>150</td>
<td>112</td>
<td>520</td>
<td>218</td>
<td>74</td>
</tr>
<tr>
<td>Ca (mg/l)</td>
<td>81.76</td>
<td>92.18</td>
<td>25.65</td>
<td>37.39</td>
<td>28.85</td>
<td>108.22</td>
<td>44.08</td>
<td>15.23</td>
</tr>
<tr>
<td>Mg (mg/l)</td>
<td>67.30</td>
<td>36.55</td>
<td>7.31</td>
<td>13.81</td>
<td>9.75</td>
<td>60.94</td>
<td>26.33</td>
<td>8.79</td>
</tr>
</tbody>
</table>

Graph of each parameter showing values from each sample site
4.2 Biological analysis

The samples were collected mostly during morning, when phytoplankton comes at the surface. The water samples were observed under microscope using different magnification. The algal species found were grouped into their respected group:

<table>
<thead>
<tr>
<th>Chlorophyta</th>
<th>Cyanophyta</th>
<th>Bacillariophyta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlamydomonas</td>
<td>Chlorella</td>
<td>Achanthes inflata</td>
</tr>
<tr>
<td>Cosmarium</td>
<td>Merismopedia</td>
<td></td>
</tr>
<tr>
<td>Chlorella</td>
<td>Anabeena</td>
<td>Navicula sp.</td>
</tr>
<tr>
<td>Spirogyra</td>
<td>Oscillatoria</td>
<td>Cymbella</td>
</tr>
<tr>
<td>Pediasrtrum</td>
<td></td>
<td>Fragillaria</td>
</tr>
<tr>
<td>Oocystis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chara</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitella</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirullina</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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