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Assessment of Impact of Mining on Water Quality and it's Modelling

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ABSTRACT

Water is one the basic needs of the mining industry. All the operations of mining, directly or indirectly require water for their functioning. The mining industry has been utilizing water carelessly without anticipating the negative impacts it is having on the ecology and the biodiversity of the region. Acid mine drainage has become a common phenomenon associated with mining. Deaths and diseases caused by contaminated water has roused concerns everywhere. The critical situation requires carrying out water analysis of all the water bodies in and around the mines to determine the source, cause, effect and remedies of the different contaminants and pollutants. This is also a part of the corporate social responsibility that the mining industry has pledged to. This also helps in reassuring the people of the pro-development motives of the mining industry. Experimental The samples are collected from two different coal mining regions, IB Valley and Talcher area, of the state of Odisha. The analysis was carried out to find the effect, coal mining activities were having on the water quality of the mines. The purpose was also to compare the effects on the water quality of the two different mines from different regions. The parameters that were determined for this purpose are temperature, pH, conductivity, TDS, DO, BOD, turbidity, acidity, sulphates, phosphates, sodium, potassium, calcium, magnesium and other trace metals.

INTRODUCTION

Water is the principal need of life on earth and is an essential component for all forms of life, from micro-organisms to man. The world's water resources are under pressure and must be managed for human survival. The need for physio-chemical analysis of water is very vital and all sources of water must be known before consumption. Mining of coal deposit all over the world are being carried out under complex hydrogeological environments causing a range of water problems affecting the production and utilization cost. Water pollution has now reached a crisis point. Almost every water body is polluted to an alarming level. The estimation of quality of water is extremely important for proper assessment of the associated hazards. The extensive mining activities also adversely affect the environment. Due to lack of proper planning and negligence of regulations an appreciable amount of environmental degradation and ecological damage to water air, and soil occurs. The problems associated with mining activities are land degradation, disposal of overburden, deforestation, washing rejects, subsidence, water pollution due to wash off, discharge of mine water, acid mine drainage, coal washing operation, air pollution due to release of gases and dust, noise pollution, mine fires etc. Water pollution from coal includes negative health and environmental effects from the mining, processing, burning, and waste storage of coal, including acid mine drainage, thermal pollution from coal plants, acid rain, and

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contamination of groundwater, streams, rivers, and seas from heavy metals, mercury, and other toxins and pollutants found in coal ash, coal sludge, and coal waste. Water contamination is inevitable. It is bound to occur due to the presence of various minerals in the rock. Our efforts should concentrate on checking the pollution levels of different parameters and keeping it within the prescribed standards. As far as concerned, water pollution due to man-made activities should be prevented in the best possible manner. This is where coal mining has the biggest impact. Our actions are not checked. In our endeavor to meet our demands and fulfill targets, we fail to realize the impact our actions can have on the environment. We also fail to realize the proper and safe use of resources around pollution prone areas. We must adopt methods that are less prone to damaging the environment, in particularly the water bodies, both the nearby and the far away ones.

LITERATURE REVIEW

Pathak and Banerjee (1992) carried out water analysis in Chapha incline of Umaria Coalfield in eastern Madhya Pradesh to determine the water quality parameters including trace element detection and microbial analyses. Sampling at the site of investigation was done by random selection so that the composition of the sample was identical to that of the parent water body. The samples were collected before the monsoon period as well as after corresponding to low and high water table conditions. The physio-chemical analysis of water comprised determination of the following parameters; turbidity, pH, total alkalinity, total dissolved solids, dissolved oxygen, Biochemical Oxygen Demand, chloride etc. To calculate WQI, an approach similar to Horton (1965) was followed. Trace metals were determined by Atomic Absorption Spectroscope. From the results it was found that the coal mine water was severely polluted. Parameters like turbidity, BOD, alkalinity and bacterial colonies were not within permissible limits as compared to standards. High cationic and anionic concentrations were also noticed. They concluded that the mining operations were having degrading effect on the WQI.

IMPACT OF COAL MINING ON WATER QUALITY

Use of water in coal mining Water as a resource is integral to process of extraction of coal both from surface and underground mines. Operations such as coal cutting in underground mines, dust suppression, coal preparation, coal washing, domestic use in mines, etc. The mines usually salvage the ground water to meet their demands and in the absence of ground water, they acquire water from the nearby water resources. Impact of coal mining Coal mining activities can directly affect the quality of the water or indirectly through processes which may show its consequences at a later stage in the life of the mine. The gravity of the impact of these activities depend on a number of factors like the geology of the area, the mineral constituents of the coal, the composition of the overburden, scale of operations, rainfall distribution, etc. Some of the major sources of water pollution in coal mining areas are 1. Mine water drainage/Acid mine drainage Coal seams sometimes have high concentration of pyrites which in presence of water and oxygen undergo oxidation to give sulphuric acid thereby increasing the acidity and pH of the water used. This water contaminates the other water bodies and the ground water when discharged from the mine. 2. Loose material runoffs The process of mining is usually associated with generation of large amount of dust and, the mineral and overburden excavated are converted to loose material. Winds pick up these dust particles along with loose material and deposit them on water bodies. Loose material is also carried by the streams running through the mines which eventually meet the main course or end into a water reservoir causing pollution in both cases.

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WATER QUALITY ANALYSIS

Water is among the most important components that make our life. It consumption and use in our day to day life has made it the most important commodity. Though our earth comprises of 71% water, only 2.5% of it is freshwater of which 98.8% is glaciated. Thus we are surrounded by very little amount of consumable water. The quantity part of the water has been figured out. Now, it is important to figure out the quality of the water. Not all rivers, streams, lakes, ponds, etc. contain water that can be consumable. The physical characteristics somewhat help in analyzing the quality of the water but it does not give the overall picture. Some waters may look fine when judged just by their physical parameters but it is not always so. There are some contaminants that are not visible to the naked eye. This is where water quality analysis comes in. Water quality helps in analyzing each and every element that can be a contaminant and thus a danger to life, the environment and the ecosystem. It important to analyze both the physical and chemical parameters of the water to ensure that the water is well within the standards for safe consumption as well to preserve the surrounding ecosystem from degradation from the contaminants. In situations where permissible limits are exceeded, the analysis helps take remedial measures and that too proper measures with right the combination of chemicals if need be. The following instruments have been used for the analysis of various parameters.

Iron:

Iron is one of the most widely used elements because of its strength and low cost. With an increase in demand of steel, mining of iron ore has increased manifold. With more steel production and iron ore mining, iron concentrations are bound to increase which is all the more reason to be concerned about. Iron is present in hemoglobin which makes it an important element for the human body. However its retention in the tissues may lead to conjunctivitis, choroiditis and retinitis. Its deficiency leads to a disease called anemia which is the decrease in the amount of red blood cells

Manganese:

Manganese compounds are abundantly found in soils. They are enormously useful in a variety of processes and industries. Its use in the steel making, ceramic industry, as oxidizers, disinfectants, in fertilizers etc. make its more the reason to found in more than appreciable concentrations in the environment. Manganese is one of the 3 essential toxic trace elements i.e. the deficiency of this toxic element could cause adverse effects. Its deficiency can cause fatness, glucose intolerance, blood clotting, skin problems, lowered cholesterol levels, skeleton disorders, etc. Over exposure to manganese mainly affects the respiratory tract and brain functions. Manganese poisoning leads to hallucinations, forgetfulness, and nerve damage. It also cause Parkinson, lung embolism and bronchitis. The dose level for animals is very low, hence their chances of survival in high manganese concentration environment becomes difficult. In plants it is required for the conversion of water to hydrogen and oxygen, hence very essential.

Nickel:

Nickel is not that abundantly found on the earth's surface. It is mainly found in the earth's core which is inaccessible. It used in making alloys, stainless steel, batteries, catalysts etc. Nickel is essential for the human body only in small concentrations. Exposure to nickel is from smoking cigarettes, tea and vegetables. High levels of nickel can lead to respiratory failure, asthma and chronic bronchitis, heart disorders, increased chances of cancer, allergic

reactions, etc. High levels of nickel concentrations can damage plants and in water they affect the algae growth.

Selenium:
Selenium is a non-metallic element and among the rarest of the elements, even rare than silver. Selenium finds it use in electronics in making photocells and solar cells. It is also widely used in the glass industry as a coloring agent or a color removing agent. Selenium essential in maintaining the health. Its deficiency can cause heart and muscle problems. High levels can cause various health effects like brittle hair, deformed nails, rashes, skin swells and severe pains. Selenium poisoning in extreme can cause death. Selenium effects on the environment depend on the nature of interaction with other compounds.

DISCUSSION

The mining industry has been expanding at a rapid rate keeping in mind the demand of the present day. For this bigger, stronger and faster machines and equipment have been invented to keep pace with the demand. Technological developments have been taking place and with it, concerns about the future of the planet. This has flagged greater safety and environmental protection measures to check the pollution caused by the mining industry. The measures taken with respect to water pollution is commendable but we still have a long way to go before we can pull the planet out of the critical situation it is presently in. The analysis was carried out using certified instruments namely multi water quality analyzer, flame photometry and atomic absorption spectrophotometry. Indian standards were used to compare the concentrations of various parameters and accordingly assess the danger each element pose to the environment. From the observation tables we find that ¬ The water samples from both the mines are acidic in nature i.e. ¬ The BOD values of water samples from both mines signify impure water. ¬ The total dissolved solids in downstream nallah of second mines is high and beyond permissible limits. ¬ The waters of both mines have high hardness values beyond the permissible limits. ¬ The selenium concentrations in water samples of both mines are relatively high and exceeding the permissible limits. ¬ The manganese concentrations in the downstream nallah of first mines is alarmingly high and more than 10 times the permissible limits. ¬ The rest of the parameters for both mines seem to be below the permissible limits.

CONCLUSION

The management of both the mines have done well to keep the concentrations of most of the parameters within the permissible limits. However they still have to be vigilant, since some of the parameters are falling outside the permissible range. The acidic nature of the water is mainly due to the pyrite content contained in the coal. The high selenium concentrations may be due the presence of selenium in the overburden and soil material. Soil testing should be carried out to verify this. It clearly shows that coal mining has certain impact on the water quality. The low pH values, high selenium concentrations and certain anomalies in some samples are testimony to it. Since awareness and restriction with regard to water quality has already been put in place by the regulatory authorities, the impact here is not as profoundly seen as the coal mining process can have.

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