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# Analysis of industrial effluents and its comparison with other effluents from residential and commercial areas in solan H.P.

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**ABSTRACT : From a public health perspective, there is a statewide need for a reliable, potable water source to compensate for population growth, water transfer issues, and over-drafted or contaminated aquifer .A laboratory work was undertaken to assess the waste water quality parameters of treated distillery effluent and their effect of various concentrations like pH, alkalinity, total solids, total dissolved solids, suspended solids, volatile and fixed solids, and settleable solids, on the quality and standard of drinking as well as water used for the agricultural purposes. A high value of these parameters indicates the high inorganic and organic load in the treated or untreated effluents. A comparison between the treated industrial effluents and untreated residential/commercial effluents was carried out in Solan town of Himachal Pradesh, where the probability of water pollution may be high due to increasing industries and educational institutions and increasing population. It is found that some of the effluents have high concentration of one or the other parameter and are beyond the permissible limits laid down byBIS/ WHO.**

**Keywords :** distillery effluent, physico-chemical analysis, pollution study, physico chemical parameters.

## INTRODUCTION

Water is an essential compound for the survival and sustenance of life on the planet earth. It is available on earth in huge amounts. It consists of the elements hydrogen and oxygen in a ratio 1:8. It is present in human, animal and plants body and carry out all the biological activities in them. Being its larger presence on earth, still there is always crisis for water. The reason being is that not all available water is potable water, and not all water is suitable for agricultural and industrial purposes, due its contamination with the unwanted substances into it. These unwanted components in water can be named as impurities. If the level of these impurities rises above the desired or permissible limits in water, these may have the various health and wealth hazards. The waste water or sewage water thrown out from industries is either used for irrigation purposes or it runs off to the natural sources of water. If these effluents are not treated before their disposal they can be harmful for human consumption as well as for other uses too.

Diverse nature of industrial effluents released from industries after treatment or untreated is disposed off into the soil and water bodies. To economize the irrigation water industrial effluents are nowadays used for the irrigation purpose, due to the scarcity of water. Also this waste water from the industries runs off to the water bodies from where the water is uplifted for the municipal distribution. The quality of water is of vital concern for mankind since it is directly linked with human welfare. It is a matter of history that faecal pollution of drinking water causes water-borne diseases which wiped out entire population of cities. At present, the menace of water-borne diseases and epidemics still looms large on the horizons of developing countries. Polluted water is the culprit in all such cases. The major sources of water pollution are domestic waste from urban and rural areas, and industrial wastes which are discharged into natural water bodies. These pollutants are large in numbers to determine. A few of these pollutants like pH, alkalinity, total solids, total dissolved solids, total suspended solids, volatile and fixed solids, and settleable solids are estimated for comparison between the treated effluents discharged by the Mohan Makin's limited distillery and the other untreated effluents from residential and commercial areas of district Solan. The results show a significant variability in the discharged waters from distillery. As the industries and population of Solan is increasing at a faster rate than other districts of Himachal Pradesh, so it becomes important to be aware about the quality of the water as it is the primary requirement of every livelihood.

## MATERIALS AND METHODS

The treated effluent was collected from the Mohan Makin's distillery, Solan, (H.P.), India where over diluted effluent has been released by the factory. For comparison the other samples were collected from the Nullah's which take off the domestic and commercial areas of Solan. These sampling stations were chosen such that the most populated or commercial complexes, educational institutions, hospitals and residential colonies falls under the periphery of the Nullah's through which the waste water runs off. The residential and commercial areas were as site1 (Old bus stand), site 2 (Sunny Side), site 3(Dhobi ghat), and site 4 (Kaushalya khad). A total of twenty five samples were collected from all sampling stations. For each sampling

station five samples were collected to check the inter-variability among the each sampling station. These five samples were collected at an approximate distance of 100-300 meters from each point. All the nullah's other than Kaushalya khad are the tributaries of river Giri (flows through Solan), while Kaushalya kahd is the tributary of river Ghagar in Haryana. The Physico-chemical properties of the effluent were analyzed following the procedure of APHA (1998).

## Sampling

The samples were collected in borosilicate bottles. As the temperature plays an important role for the preservation, it was taken care that sample must be kept at minimum temperature i.e. at $4^oC$. The determination of all parameters which was supposed to carry out in our experiment was done within 24 hours of the collection of water samples. To bio-assay the concentration of the effluent control, 25%, 50%, 75% and 100% was made by diluting the effluent with distilled water in the ratio of 0:1, 1:3, 1:1, 3:1 and 1:0, respectively. Also the sampling bottles were previously cleaned by washing in non-ionic detergent, rinsed with tap water and later soaked in 10% $HNO_3$ for 24 hours and finally rinsed with deionised water prior to usage. During sampling, sample bottles were rinsed with sampled water three times and then filled with full precautions from each of the designated sampling stations.

## Methodology

pHs value of any aqueous solution is the measure of negative logarithm of hydrogen ions concentration. For acidic solutions the pH value is less than seven, for basic solutions the value is more than seven, while for neutral solutions the value is equal to seven. The pH values for Mohan Makin's treated effluents sample were ranged between 7.6-8.3 for all five samples. The pH value for site 1 ranges between 7.9-8.8, at site 2 pH vales were 7.3-7.9, at site 3 the pH value was ranging between 7.8-8.3 and for site 4 the pH ranges were between 6.9-7.6. As per BIS directions the pH for the effluents discharged for industrial and municipal treatment plants should be 6.5-8.5. Here in our study it was found that all samples have pH value in this range except for site 1(Old bus stand).

Alkalinity can be defined as the ability of wastewater to neutralize acids; it is a measure of buffering capacity against a pH drop. Total alkalinity was determined by visual titration method using methyl orange indicator. The alkalinity of the treated effluents of the distillery in terms of $HCO^-_3$ of all samples ranged from 154-168 mg/L respectively. But this methyl orange alkalinity for the other samples of site 1 ranged between 174-194 mg/L, while this for site 2 was 131-138 mg/L, for site 3 methyl orange alkalinity found to be between 149-164 mg/L, and for site 4 it was between 124-130 mg/L.

Total solids, TS, are defined as the residue remaining after a waste water sample has been evaporated and dried at a very high temperature. Total solids include total suspended solids, the portion of total solids retained by a filter and total dissolved solids, the portion that passes through the filter. On estimation for total solids for the distillery's effluents ranged between 3075-3420 mg/L, and at site 1 it was 6500-9075mg/L, at site 2 these were analyzed to be in a range 2250-2995mg/L, while at site 3 these were 550-750 mg/L and that for site 4 the range was 365-500 mg/L. Dissolved and suspended solids for the distillery and other non industrial or residential areas were estimated and it was found the industrial effluents contains the total dissolved solids as 1150-1300 mg/L, while for other sites total dissolved solids were 2660-4225 mg/L, 660-990 mg/L, 375-500 mg/L, and 272-400 mg/L for site 1,2,3 and site 4 respectively. TSS concentrations in industrial effluents were found in range 1975-2120 mg/L. for sites 1,2,3 and 4 these were found 3840-5000 mg/L, 1575-2005 mg/L, 175-250 mg/L, 93-105 mg/L respectively. The volatile , fixed and settleable solids concentrations for distillery lie in ranges 915-960 mf/L, 2175-2460 mg/L, and 5.4-5.8 ml/L respectively. The concentrations of volatile, fixed, and settleable solids, for site 1,2,3 and 4 were in ranges TVS(1475-1875 mg/L), TFS (5025-7200) mg/L and SS(9.8-11.1) ml/L respectively for site 1. For site 2 the data for TVS, TFS, and SS comes out to be in between ranges 460-615 mg/L, 1790-2380 mg/L, and 6.9-7.9 ml/L respectively. For site 3 the ranges of TVS, TFS, and SS were 120-275 mg/L, 410-520 mg/L, and 5.6-6.0 ml/L respectively. At site 4 the TVS, TFS, and SS concentrations were 125-299.5 mg/L, 127-375 mg/L, and 3.9-4.3 ml/L respectively.

## RESULTS AND DISCUSSION

A total 25 samples of sample of effluents were taken from the different nullah's in Solan town and nearby areas which are used for various purposes like irrigation and municipal drinking water supply. A total five samples of industrial effluents from Mohan Makin's limited were taken to study the physicochemical parameters and were compared with other commercial and residential effluents and comparisons were made in industrial and non industrial area. In this study it was found that the primary treated effluents from distillery are in permissible limits of WHO and BIS. The pH of distillery was found 7.6-8.3, which is in ranges specified by BIS and WHO. Also the other parameters like alkalinity, TDS, and Settleable Solids of this industry lie in BIS and WHO guidelines value for drinking water. During this study it is found that the most polluted effluents are being disposed from the Old Bus Stand site (1) nullah. This nullah has the highest values of pH, alkalinity, TDS and suspended Solids which may be hazardous for drinking purpose if it is not treated well before its disposal into the rivers. The value of all parameters from this nullah exceeds the guidelines provided by BIS and WHO. The other nullah

of town i.e. sunny side which is a residential and also some institutions are situated in this area. The physicochemical parameters of the effluents from this nullah have the concentrations in permissible limits by BIS/WHO standards. Dhobigahat nullah (site 4) takes off the effluents from residential and commercial areas. The concentrations of pH, alkalinity, TDS and other parameters again lie in the permissible limits laid down by BIS/WHO. The fourth site *i.e.*, Kaushalya Khad has the least polluted effluents in all comparison.

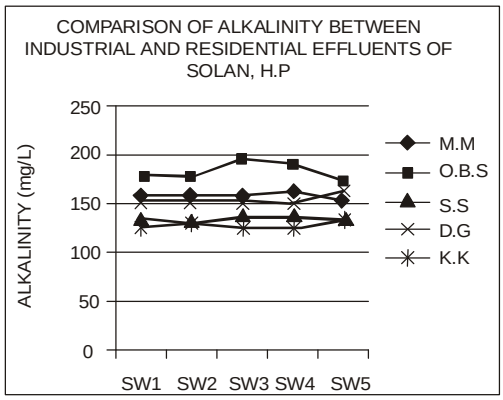


**Fig.1.** Variation alkalinity in effluents of Mohan Makin's Distillery and residential/commercial areas at Solan, H.P.

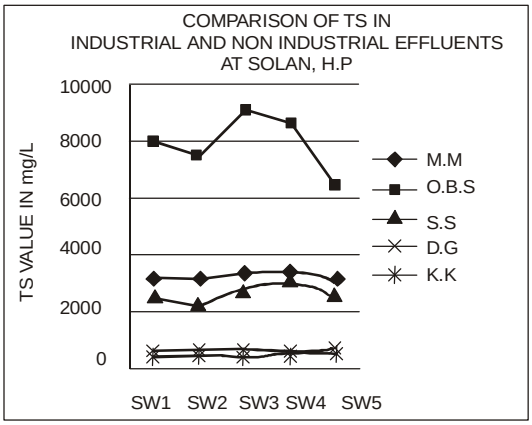


**Fig.2.** Variation in pH of effluents of Mohan Makin's, Mohan Makin's distillery and residential/commercial ares at Solan, H.P.

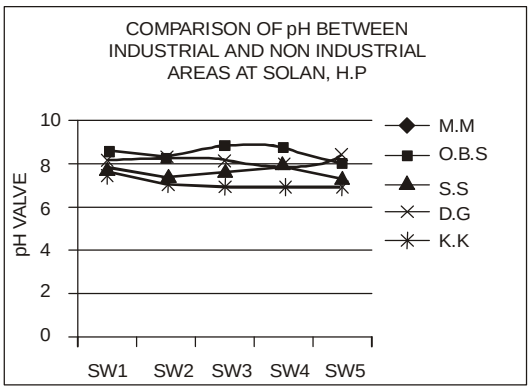


**FIg.3.** Variation in total solids in effluents of Mohan Makin's distillery and residential/commercial areas at Solan, H.P.

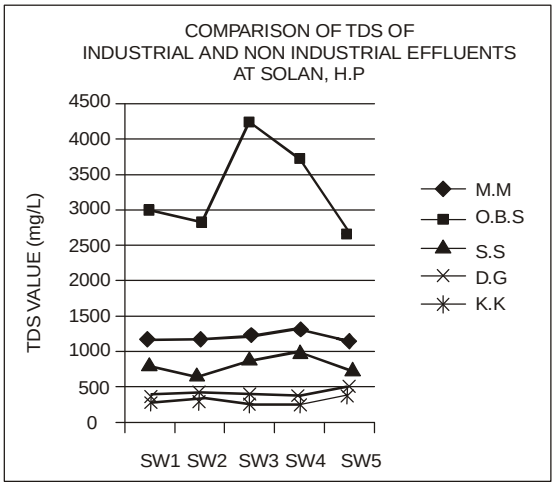


**Fig.4.** Variation in total dissolved solids in effluents of distillery and residential/commercial areas at Solan, H.P.

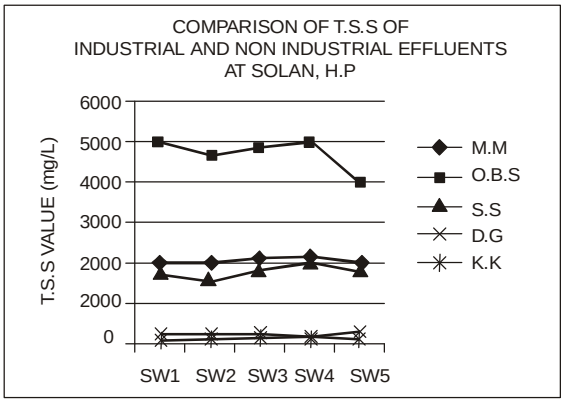


**Fig.5.** Variation in total suspended solids in effluents of Mohan Makin's distillery and residential/commercial areas of Solan, H.P.

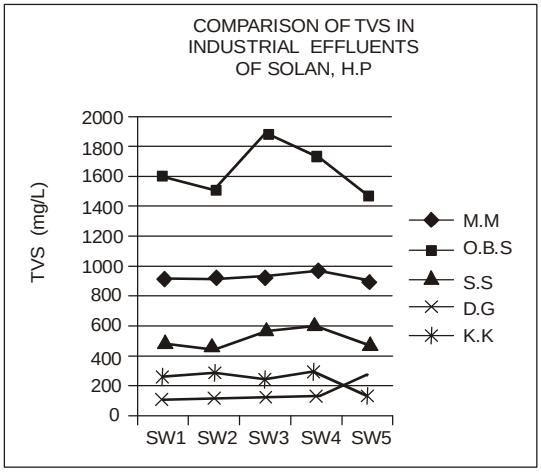


**Fig.6.** Variation in total volatile solids in effluents of Mohan Makin's distillery and residential/commercial areas of at Solan, H.P.

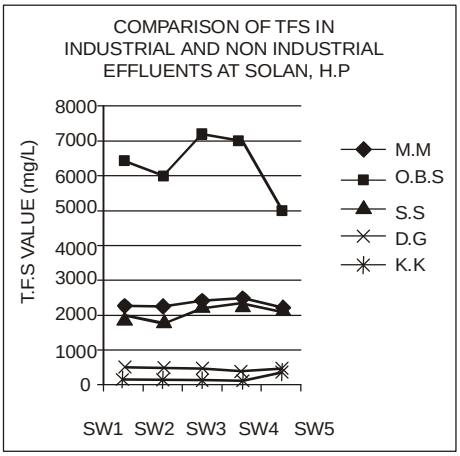


**Fig.7.** Variation in total fixed solids in effluents of Mohan Makin's distillery and residential/commercial areas of at Solan, H.P.

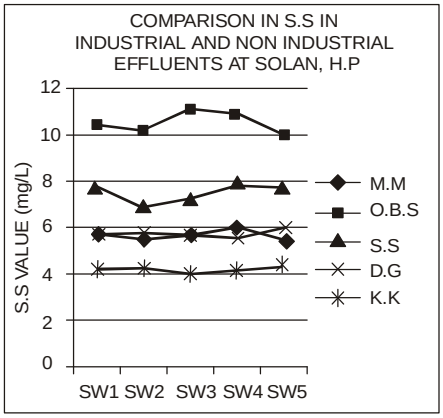


**Fig.8.** Variation in total settleable solids in effluents of Mohan Makin's Distillery and residential/commercial areas of at Solan, H.P.

Although pH does not cause any harm to the aesthetic appeal of water, but its higher values can cause corrosive action to the pipes and containers. Also a higher value of pH can make soil acidic if used excessively for irrigation. Total alkalinity is a measure of the ability of the water to neutralize acids. The constituents of alkalinity in neutral system include mainly carbonate, bicarbonate, hydroxide and other components which may contribute to alkalinity are H2BO32-, HPO42- and HS-. These compounds result from dissolution mineral substances in the soil and atmosphere. Alkalinity is a big problem for industries also, as alkaline water if used in boilers for steam generation may lead to precipitation of sludge, deposition of scales and cause caustic embrittlement. This study also indicates that any industry establishment in this area must have alkalinity treatment plant prior to use of ground water or should go for some alternate water source. Total solids also called total residue is related to turbidity, except that it includes not just suspended solids, but also dissolved solids such as the mineral ions calcium, phosphorus, iron, sulfur and bicarbonate. A certain level of these ions is essential for life. Total solids concentration is one of the most important domestic, industrial and agricultural water quality parameters. This is because the salinity of the soil water is related to, and often determined by, the salinity of the irrigation water. Accordingly, plant growth, crop yield and quality of produce are affected by the total dissolved salts in the irrigation water. Equally, the rate of accumulation of solid salts in the soil, or soil salinization, is also directly affected by the salinity of the irrigation water. Total suspended solids are the measure of turbidity in water. The water becomes unclear due to the presence of suspended solids; increase in the concentration of TSS decreases the clarity in water. Clay, silt, and sand from soils, phytoplankton (suspended algae), bits of decaying vegetation, industrial wastes and sewage are common suspended solids. Suspended solids also provide adsorption surfaces and a route of transmission for many organic contaminants, heavy metals, and some nutrients. Many of the most toxic industrial compounds such as dioxins and furans, PCB's (polychlorinated biphenyls), PAH's (polycyclic aromatic hydrocarbons), many pesticides and heavy metals. Which may lead to the settlement of these heavy metals at the lower surface and may cause silt problems. The presence of total settleable solids either in effluents or flowing water may also lead to the sedimentation under the water surface, due to which the water level in the sources may rise which may become a problem in future.

The higher ranges of TVS and TFS were found in at site 1 *i.e.*, Old Bus Stand Nullah, while these were recorded minimum at site 3 and 4. Actually, TVS are the organic solids which contain carbohydrates, fats and oils, nitrogenous compounds such as proteins and their decomposed products. Organic nitrogen is not immediately available for biological activity. Therefore, it does not contribute to furthering plant proliferation until decomposition to the inorganic forms of nitrogen occurs. While the Fixed solids are inorganic solids of minerals such as sand gravel and salts etc. Although these all are not producing health hazards but higher amounts can cause the loss in aesthetic appeal of drinking and other waters.

## CONCLUSIONS

The industrial and non industrial effluents were taken from the various places of in and around Solan City town were analyzed and the analysis reports that the water quality parameters like pH, Alkalinity, Total Solids, TDS, TSS, TVS, TFS and SS for most of the treated and non treated effluents lies within the maximum permissible limit prescribed by BIS and WHO. Except few parameters like TS, TDS, TVS of few non treated effluents from residential/commercial samples were reported with higher value than the permissible level, but this value does not have any impact for the water to use for drinking purpose. Because these sources of effluents meets the rivers from where water is uplifted for drinking purposes after the secondary treatment. But, as the population and industries are increasing with a faster rate

in Solan, it becomes necessary to have a constant check on the quality of environment and especially water and its sources.

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