Madras Agric. J., 104 (10-12): 327-329, December 2017

# Effect of Biomethanated Distillery Spentwash on Ground Water Quality

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**Spentwash is a highly concentrated liquid waste discharged from distillery industry. This effluent is used as liquid fertilizer by many farmers due to its high load of nutrients. But, due to continuous spentwash irrigation the salts and nutrients present in the effluent leach to ground water creating environmental issue. Piezometers were installed in farmers field at a depth of 0.5 m in both spentwash applied and control fields and the leachates were collected on 30, 60, 90 and 120$^{th}$ day after spent wash application to monitor the groundwater leaching. The results indicated that, EC and salt content of the leachate increased initially at 30$^{th}$ day and it was found to be decreased from 60$^{th}$ day. Hence, spentwash must be applied judiciously according to crop requirements and soil fertility status to prevent groundwater contamination with nitrate, salts and other toxic ions.**

**Key words:** Spentwash, Piezometer, Groundwater quality

Spentwash is a liquid waste discharged from alcohol production. The effluent after Biomethanation contains appreciable amounts of macro- and micronutrients such as K, N, Fe, Cu, Zn and B, which are essential for plant growth (Jain *et al*., 2005). Gloeden *et al*. (1991) concluded through geological and hydro geological surveys that Cl, Organic Carbon, $NH_4$ and organic N present in vinasse affected the ground water quality of sugarcane cultivated area when vinasse was applied @ 300 $m^3$ $ha^{-1}$. Orlando, (1996) reported the comparative test on the use of vinasse and mineral N with regard to leaching of N from the soil and possible pollution of ground water, no $NO_3$ or other free N compound were found in samples at depth of 2 m, presumably because N in the soil was fixed microbiologically. Jain et al. (2005) reported that the total dissolved solids and anion cation levels were higher in the field receiving Post-methanated Distillery Effluent than in the unamended field. The Total Dissolved Solids (TDS) levels in the piezometer and tubewell samples in the amended field ranged from 441.6 to 998.4 mg $L^{-1}$ and 332.8 to 812.8 mg $L^{-1}$, respectively. High salt content and TDS in ground water due to effluent irrigation have also been reported by Joshi, (1999). Chonker et al. (2000) observed that use of Post-methanated Distillery Effluent should be discontinued intermittently for one to two crop-seasons to avoid the deteriorating effects on soil and ground water quality.

The farmers in the adjoining areas of molasses based distilleries often use the effluent for irrigating crops without considering its impact on the ground water. The Biomethanated Distillery Spentwash (BDS) discharged from M/s. Bannari Amman Sugars Ltd., located at Sathyamangalam Taluk, Erode district, Tamil Nadu, was applied to surrounding farmer field as a source of nutrient for the crops grown in their field. This may increase the chances of groundwater contamination by leaching of Biomethanated Distillery Spentwash (BDS) and affect the groundwater quality by increasing the salt content. Monitoring of ground water beneath the effluent irrigation site is important to maintain its quality because of the risk due to leaching of organic and inorganic ions from effluent irrigated fields. The current study aims in monitoring leaching of BDS to groundwater through piezometer and also to study the effect of BDS on salt content of groundwater.

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## Material and Methods

To monitor the leaching of BDS to ground water piezometers were installed in Modhur near Sathyamangalam in Erode district, Tamil Nadu at a depth of 0.5 m in farmers field during the month of August in 2015 and the leachates were periodically collected (30, 60, 90 and on 120$^{th}$ day after BDS application) and analyzed for physio-chemical charecterics. The soil was loamy in texture and the field was irrigated at an interval of 10 days throughout the crop period. An average rainfall of 13.75 mm was observed during the course of study.

### *Installation of piezometers*

Piezometers were installed in the farmer's field at a depth of 0.5m to monitor the leaching of BDS and salt movement to groundwater. A hand operated piling was used to dig holes for piezometer installation. The piezometers were made from slotted PVC pipes that were covered with mesh at the base, and then

inserted into the holes. The space around the tubes was backfilled with sand till the level of holes and then with white cement and followed by clay to prevent preferential flow pathways developing outsides of the PVC tubes. PVC tube extended above the soil surface for 0.3 m, to avoid the surface water flow entering into the piezometers. Finally they were end capped to avoid rain filling the tubes (Fig.1). The design of the piezometers is prepared on the models of nested piezometers by Aarons *et al*. (2004). After completing this process piezometers were installed in both control and treated field and BDS was applied at a rate of 40 KL $ac^{-1}$ in treated field. The leachates were collected at an interval of 30, 60, 90 and 120$^{th}$ days after BDS application and analysed for pH, EC, cations and anions as per the standard procedure (APHA, 1998).

## Result and Discussion

### *Effect of BDS application on pH*

The mean pH ranged between 8.75 and 8.97. The pH was high in field which received BDS compared to the control field. The pH of the leachate increased over the days after planting and the highest pH (9.14) was observed in spentwash treated field at 120 days after BDS application. Saliha (2003) also reported an increase in pH of the leachate with leaching events in the sodic soil treated with distillery spentwash. The increase in the pH might be due to addition of salts by spentwash which favours alkalinity and continuous release of exchangeable bases *viz*., Ca, Mg, Na and K in the soil solution (Sridharan, 2007).

### *Effect of BDS application on EC*

The mean EC of the leachate was 0.98 dS $m^{-1}$ in control and 1.41 dS $m^{-1}$ in treated (Table 1) fields respectively .The EC of the leachate increased with spentwash application and it decreased over the period of collection. Since the salts present such as chlorides and sulphates in the spentwash are highly soluble in nature, they might have been leached down along the movement of water, thereby resulting in high EC in the spentwash applied field compared to control.

The salt accumulation in soil depends on many factors. One of the major factors is seasonal effect. When there is heavy rainfall, there may be chance of more leaching from surface layer which may increase the salts at deeper layer of soils. The impact of rainfall was clear from the depth wise increased EC for both the treatments. The high EC in spentwash plots compared to control may be that the salt loading was very high due to spentwash containing high TDS. Kumar *et al*. (2011) reported that the increase in EC was very well correlated with the increase in the levels of spentwash application and application of spentwash at higher rates might lead to build up of salts in the soil and ground water.

**Table 1. Effect of BDS on groundwater leachate**

| Parameters | 30days | | 60 days | | 90 days | | 120 days | | Mean | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Control | Treated | Control | Treated | Control | Treated | Control | Treated | Control | Treated |
| pH | 8.66 | 8.78 | 8.75 | 8.98 | 8.78 | 9.00 | 8.84 | 9.14 | 8.75 | 8.97 |
| EC (dS $m^{-1}$) | 1.03 | 1.62 | 0.99 | 1.48 | 0.96 | 1.31 | 0.94 | 1.26 | 0.98 | 1.41 |
| Ca (meq $L^{-1}$) | 3.56 | 6.02 | 3.40 | 3.83 | 3.09 | 3.72 | 2.69 | 3.58 | 3.18 | 4.28 |
| Mg (meq $L^{-1}$) | 2.90 | 3.19 | 2.79 | 3.01 | 2.67 | 2.88 | 2.57 | 2.83 | 2.73 | 2.97 |
| Na (meq $L^{-1}$) | 1.95 | 2.45 | 1.90 | 2.21 | 1.68 | 2.09 | 1.46 | 1.96 | 1.74 | 2.17 |
| K (meq $L^{-1}$) | 0.93 | 4.10 | 0.87 | 2.53 | 0.85 | 1.95 | 0.83 | 1.87 | 0.87 | 2.61 |
| Cl (meq $L^{-1}$) | 3.44 | 6.16 | 3.30 | 5.44 | 3.13 | 4.04 | 2.78 | 3.11 | 3.16 | 4.68 |
| SO42- (meq $L^{-1}$) | 3.21 | 6.43 | 3.09 | 5.61 | 2.95 | 4.23 | 2.71 | 3.49 | 2.99 | 4.94 |

*The values are average of three observations.

### *Effect of BDS application on cations and anions*

Both the cation and anion content of the leachate increased with spentwash application and decreased over the period of collection . Among the cations, Ca dominated and they were in the order of Ca > Mg > Na > K. Among the anions, Cl dominated and they were in the order of Cl > $SO_4$ > $HCO_3$. The salt content showed decreasing trend from 60$^{th}$ day compared to 30$^{th}$ day after BDS application (Fig 2). The highest value of Ca (6.02 meq $L^{-1}$), Mg (3.19 meq $L^{-1}$), K (4.1 meq $L^{-1}$), Na (2.45 meq $L^{-1}$), Cl- (6.16 meq $L^{-1}$) and $SO_4^{2-}$ (6.43 meq $L^{-1}$)was recorded in treated field in 30$^{th}$ day after BDS application whereas the lowest Ca (2.69 meq $L^{-1}$), Mg (2.59 meq $L^{-1}$), K (0.83 meq $L^{-1}$), Na (1.96 meq $L^{-1}$), $Cl^-$ (3.44 meq $L^{-1}$) and $SO_4^{2-}$(3.21 meq $L^{-1}$) was observed in control field at 120$^{th}$ day after BDS application (Table 1).

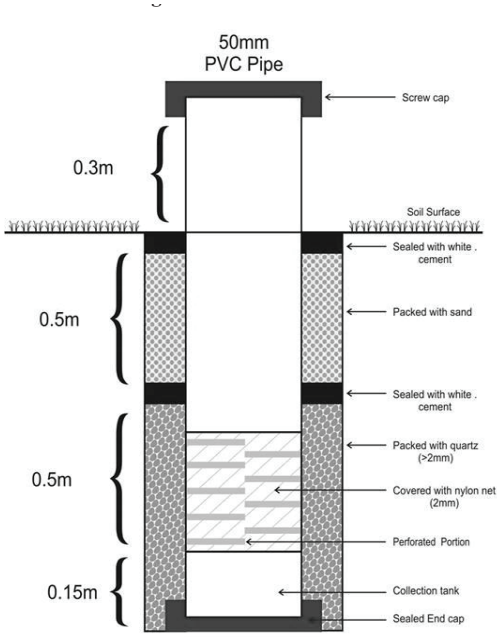


**Figure 1. Structure of a Piezometer**

Shenbagavalli *et al*. (2011), reported that the ground water samples from spentwash applied field contained large amount of salts, particularly $K^+$ and Cl suggesting that the water contamination is mainly due to the application of distillery spentwash. Latha *et al*. (2013) reported that there was an increase in pH, EC, anions and cations content due to the application of spentwash over the recommended dose and were within the critical limits and have not influenced the ground water and there is no possibility of pollution by BDS application.

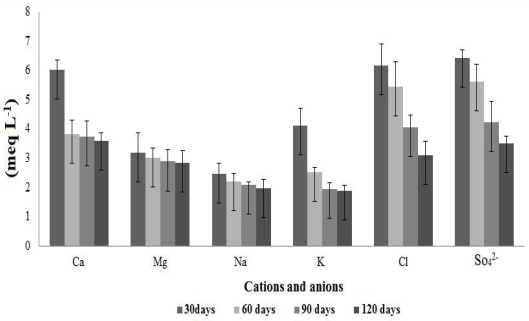


**Figure 2. Effect of BDS application on cations and anions**

The spentwash contained high concentration of Cl which might have enriched the soil solution with soluble Cl resulted in greater concentration of this ion in the leachate (Latha *et al*., 2013 ). Although leaching of salts has the potential to affect the quality of groundwater, the actual impact will depend on the rate of recharge of groundwater, initial status of groundwater quality and agro-management practices followed in the area.

## Conclusion

The pH and EC of the leachates increased at 30th day after BDS application and decreased at 60th day after BDS application. Among the cations in leachate, Ca dominated and they were in the order of Ca > Mg > Na > K. Among the anions, Cl dominated and they were in the order of Cl > $SO_4$ > $HCO_3$. The salt content gradually decreased from 60th day after BDS application compared to 30th day after BDS application. Therefore, spentwash must be applied judiciously according to crop requirements and soil fertility status to prevent contamination of shallow groundwater with nitrate and other toxic ions.

***Acknowledgement***

The authors are thankful to M/s. Bannari Amman Sugars Distillery division Ltd., Erode for their support and financial assistance provided during the course of investigation.

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Received : August 28, 2017; Revised : December 21, 2017; Accepted : December 29, 2017