Enhancing quality of distillery effluent (DE) through sequential adaptation of indigenous bacterial and algal consortium and its reuse potential for irrigation

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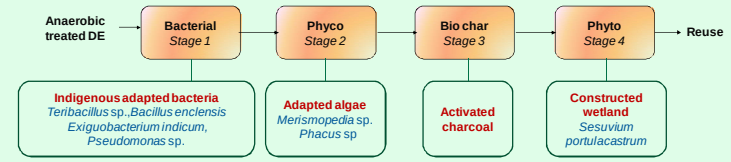
Background

Distillery effluents comprise high load of pollutants like chemical oxygen demand (COD), biological oxygen demand (BOD), melanoidin etc. Disposal of the untreated or partially treated DE are toxic and cause adverse effect on soil, water, air, human and animal health. Attempts are seldom made by some industries to sprinkle the DE on press mud and convert it as value added bio-manure for safe and productive disposal. Yet COD, BOD and melanoidin of the effluent which is beyond the permissible limit remains a challenge leading to soil health problems on repetitive usage. Therefore a cost-effective hybrid treatment sequence combining bacterial, phyco and phyto remediation to improve quality of DE and demonstrate its reuse potential in agriculture is vital.

Sequential bio-remediation process

A four stage squential process comprising of bacteria, algae, charcoal followed by constructed wetland was adopted to remediate the anearobic treated DE



Sequential treatment plant

Terribacillus goriensis MSSRFW1 Genbank No: KP008149	*Pseudomonas* sp. MSSRFD41 Genbank No: HQ454991	*Exiguobacterium indicum* MSSRFW2	*Bacillus enclensis* MSSRFW3

Adapted bacterial consortium

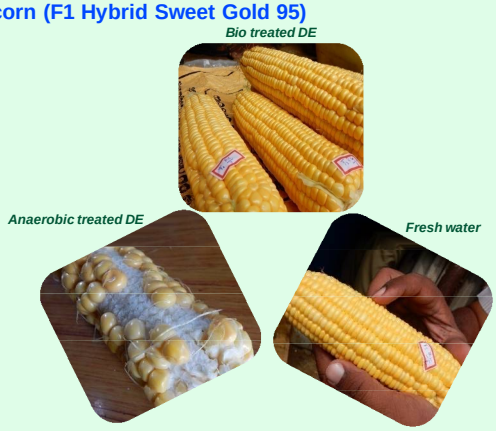
Water quality changes

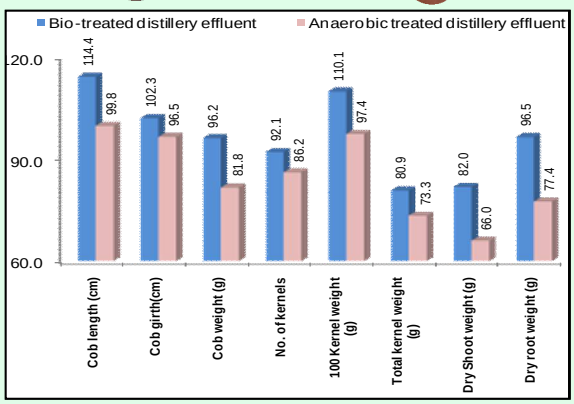
- DE quality enhanced significantly on reduction of COD, BOD, colour, TSS, Sulphate, Nitrate, and Calcium
- Bacterial treatment, enhanced pH and melanoidin degradation which enabled better penetration of sunlight creating environment for the growth and adaption of algae in DE which is a novel finding
- Growing algal cells favoured degradation, adsorption and settlement of contaminants.
- Activated charcoal removed the contaminants and biomass before reuse

Parameters	Initial status	% Reduction
pH	6.5	7.2
Eh (mV)	39.5	-10.5
Ec (mS/cm)	17.3	3.5
Salinity (PPT)	8.6	2.1
Temperature (°C)	32.7	7.2
COD (mg/L)	53000.0	87.9
% Colour removal	C	65.4
BOD (mg/L)	15600.0	89.7
TDS (mg/L)	75781.5	61.1
TSS (mg/L)	17625.0	80.7
Phosphate (me/L)	1475.0	61.9
Chloride (me/L)	501.7	63.4
Magnesium (me/L)	303.3	25.7
Sulphate (me/L)	94.7	81.0
Nitrate (me/L)	137.0	81.8
Calcium (me/L)	149.7	70.5

Reuse of treated DE

Sweet corn (F1 Hybrid Sweet Gold 95)





Yield attributes of Sweet corn

Halophytes

Sesuvium portulacastrum *Suaeda maritima*

- Sweet corn irrigated with bio-treated DE performed significantly better than anaerobic treated distillery effluent.
- No significant difference was observed in sweet corn crop quality irrigated with bio-treated DE and fresh water indicating its suitability for irrigating edible crops
- Halophytes like *Sesuvium portulacastrum* and *Suaeda maritima* showed luxuriant growth due to saline content in DE

Major Outcomes

- Novel and low cost approach to ehnance treatment efficiency acheived by sequencing bacterial follwed by algal consortia
- Halophyte can be a potential phyto remediant for uptaking salinity from DE
- Bio treated DE is potential source of irrigation for edible crops without affecting crop and soil health

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