ENVIRONALGAE

Your partner for sustainable effluent treatment

Introduction

The impact of *Climate Change* is well known and gets discussed in perhaps every important international convention of developed and developing nations. Our manufacturing sector is tasked to audit and reduce our *Scope 1*, *Scope 2* and *Scope 3* carbon emissions. For most of the chemical, food, feed, agro-processing, agrochemical, pharmaceutical and fine chemicals industry, *Scope 1* and *Scope 2* emissions from wastewater treatment are significant. Hence, switching to more sustainable wastewater mitigation technologies is a need of the hour for most companies.

Microalgae are the most primary photosynthetic organisms on the planet. Their smaller sizes, robust cell structure and an efficient photosynthesis apparatus make them the most efficient plants on the planet. Microalgae are present abundantly in nature, thereby rendering a "Natural" process for effluent treatment.

Why microalgae for wastewater treatment?

Microalgae provide unique advantages:

- Utilize sunlight as the primary energy source
- Ensure oxygenation of the discharged effluent
- Metabolize COD with low BOD:COD ratios
- Absorb and metabolize CO_2
- Absorb and utilize ammonia & nitrates
- A single-step process
- Pliable across wide range of pH, TDS COD loading rates, stream compositions and weather conditions
- Opportunity to commercialize algal biomass as a feedstock for food, feed & high-value fertilizers

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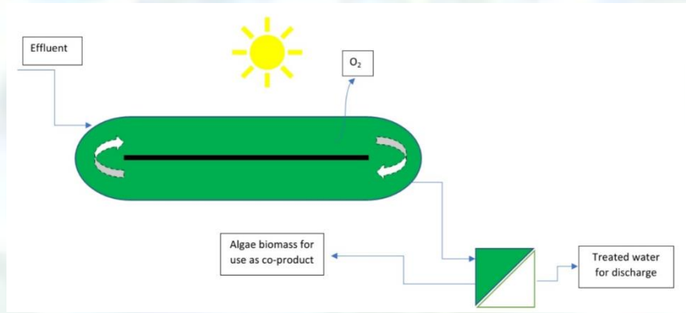
Harnessing the prowess of microalgae for wastewater treatment

What does the process look like?

- Under-the-sun set-up (low civil-work)
- Simple unit operations and processes
- Safe, clean & healthy (O_2 spa!) process



How do we proceed?

This is a niche area of technology for wastewater treatment. We believe in offering a technology solution rather just selling a project or consulting services.

Phase	Phase description	Duration
SCIENTIFIC FEASIBILITY ASSESSMENT	Bioassays at our lab	1 month
TECHNICAL FEASIBILITY ASSESSMENT	Process development at our lab	1½ months
VALIDATION ASSESSMENT	Outdoor validation at our Pilot-plant	1 month
DESIGN	Design of the full-size ETP	2 months
EXECUTION & COMMISSIONING	Execution and Commissioning of the full-size ETP plant	3-4 months

Why work with us?

- Passionate about the environment
- Among the very few across the world to have executed full- microalgae-based effluent abatement at scale!
- Executing microalgae-based effluent treatment projects, two are perhaps among few of the largest of their kind in the world

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Our ETP emits pure oxygen! Do you want some?

- Team experienced in R&D, technology & business leaders with illustrious corporate careers prior
- Follow a *phase-gate* approach with focus on **demonstrating customer value creation**; *invest CAPEX once recovery is assured*!
- Deliver customized process technology solutions for your needs

Promoter Profile

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EXECUTIVE PROFILE

Chemical engineering professional with leadership experience in R&D, Techno-commercial, Manufacturing and Business roles, with proven track record of evaluating, conceptualizing, innovating, developing, scaling-up, delivering process & business solutions, and business growth. Subject matter expertise in climate change mitigation solutions, biofuels, biochemical engineering, bioprocess engineering, wastewater treatment, design & scale-up of unit operations and processes from concept to commercial scale, in bioprocess applications.

EDUCATIONAL QUALIFICATIONS

- MS, PhD in Chemical Engineering from Colorado State University, USA, 2005
- BTech in Chemical Engineering from Dr. B. A. Technological University, Lonere, India, 2000

KEY PROJECTS/ EXTERNAL REPRESENTATIONS

- Executing some of the largest known microalgae-based effluent treatment projects in the world, with the largest one exceeding 2 Million Liters per day of treatment capacity
- Conceptualized, developed, and designed (process design) the first-of-its-kind algae-based wastewater treatment solution to mitigate all aqueous effluent streams at site. Saved millions of pounds in CAPEX-OPEX and carbon emissions for the manufacturing site.
- Conceptualized & designed (2012-13), commissioned (2016), demonstrated (2017) and operated (2017-Aug'2018) the world's first integrated, end-to-end, large demonstration plant for biocrude production using marine microalgae produced from CO_2
- Successfully secured funding as a co-Principal Investigator from RIL in the United States Department of Energy (US DOE) sponsored PACE (Producing Algae for Chemicals & Energy) project in 2015.
- Participated as a co-Principal Investigator from RIL in the US DOE sponsored NAABB (National Alliance for Algae Biofuels & Bio-products) from 2011-2014.
- In 2009, PRAJ contributed significantly towards the preparations of the Indian Prime Minister's Convoy to Copenhagen Summit. Was a key member of the team that conducted, compiled & presented life cycle analyses studies on a few renewable energy options, to the PM's Convoy.

Contact information

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An Exciting Clean-Tech for Effluent treatment….

- **Sustainable** - Sunlight, the primary source of energy for our process, is free of cost, non-polluting and plentiful
- **Environment friendly*** - O_2 released by algae, improves overall air and water quality in the environment
- **Effective** (field data collected from one of our pilot-plant sites)

Raw effluent
- COD – 6,000 mg/L
- pH – 4.5
- TSS - ~1,000 mg/L
- Red coloration

Algae pond culture
- DO – 150-500% sat.
- pH – 7-8
- Green algal cells in suspension

Treated water
- COD – 60-120 mg/L
- pH – 7-8
- TSS - < 20 mg/L

- **Lucrative** – Renewable algae biomass generated has potential value as feed, food and organic fertilizer. Protein content > 50%, high-value fats > 10% and high mineral and antioxidant content.

* – Most of the natural water body pollution by algae is from toxic blue-green algae (cyanobacteria), we are proposing use of beneficial green microalgae for this application

Typical composition of fresh-wet microalgal slurry

Typical composition of algal biomass (on wet-cake basis; 10% solids) CENTRIFUGED FRESH SLURRY		
COMPONENT	**CONTENT**	**REMARKS**
Water	90.0%	Over half of this is water present inside the algal cells
Proteins	5.0%	Attractive amino acid profiles
Fats	1.5%	High MUFA & PUFA content, no trans fats
Carbohydrates	1.5%	Fiber content
Minerals	1.5%	Mg, Ca etc.
High-value phytochemicals	0.5%	Antioxidants and pigments
Tremendous potential as a feedstock for Feed/ Fertilizers/ Biochemicals/ Food		

Approximate Outlay and Financials

	30 KLD ETP	300 KLD ETP	3,000 KLD CETP	10 MLD STP	150 MLD STP
COD assumed, mg/L	4,500	4,500	4,500	750	750
Land required, acres	0.33	2.8	28	19	278
CAPEX, ₹Crores	0.83	3.5	26	13.9	139
OPEX*, ₹Crores/ year	0.4	1.7	8.7	4.9	56
Algae# generation, MT/year	134	928	9,281	4,950	74,250
Annual Margin, ₹Crores/ year	0.07	1.6	24	7.4	129
Return on CAPEX	8%	46%	90%	54%	93%
Payback on CAPEX, years	12.1	2.2	1.1	1.9	1.1
CO_2 Emm. Reduction MT/year	-	354	3,538	1,678	25,174
O_2 released MT/year	78	653	6,535	4,357	65,350

Algae wet cake at 10% solids concentration sold at ₹25/kg from STP and ₹35/kg from ETP; *After accounting for interest on CAPEX @8% and depreciation of CAPEX over 10 years