Sewage Treatment for Clean Effluent and Water Reuse

Emission Compliance and River Water Quality

Sewage Treatment Process (STP) to produce clean effluent suitable for discharge to clean rivers or recreational beaches, or for water reuse after some further polishing has to be designed to produce clean effluent (such as the Malaysian Standard A in Table 1, or even up to Class III as in Table 2). This treated effluent water may be reused to replenish city river or lake water, where it would undergo further in-river treatments to become a water of Class II (Table 2) that is suitable for recreational activities, or for treatment into potable water.

Table 1. Environmental Quality(Sewage)Regulation 2009

Parameter	Unit	Std A	Std B
(a) Temperature	°C	40	40
(b) pH Value	—	6.0-9.0	5.5-9.0
(c) BOD5 at 20°C	mg/L	20	50
(d) COD	mg/L	120	200
(e) Suspended Solids	mg/L	50	100
(f) Oil and Grease	mg/L	5.0	10.0
(g) Ammoniacal-N (lake*)	mg/L	5.0	5.0
(h) Ammoniacal-N (river)	mg/L	10.0	20.0
(i) Nitrate-N (river)	mg/L	20.0	50.0
(j) Nitrate-N (lake*)	mg/L	10.0	10.0
(k) Phosphorous (lake*)	mg/L	5.0	10.0
*enclosed water body			

Table 2. National Water Quality Standard Malaysia

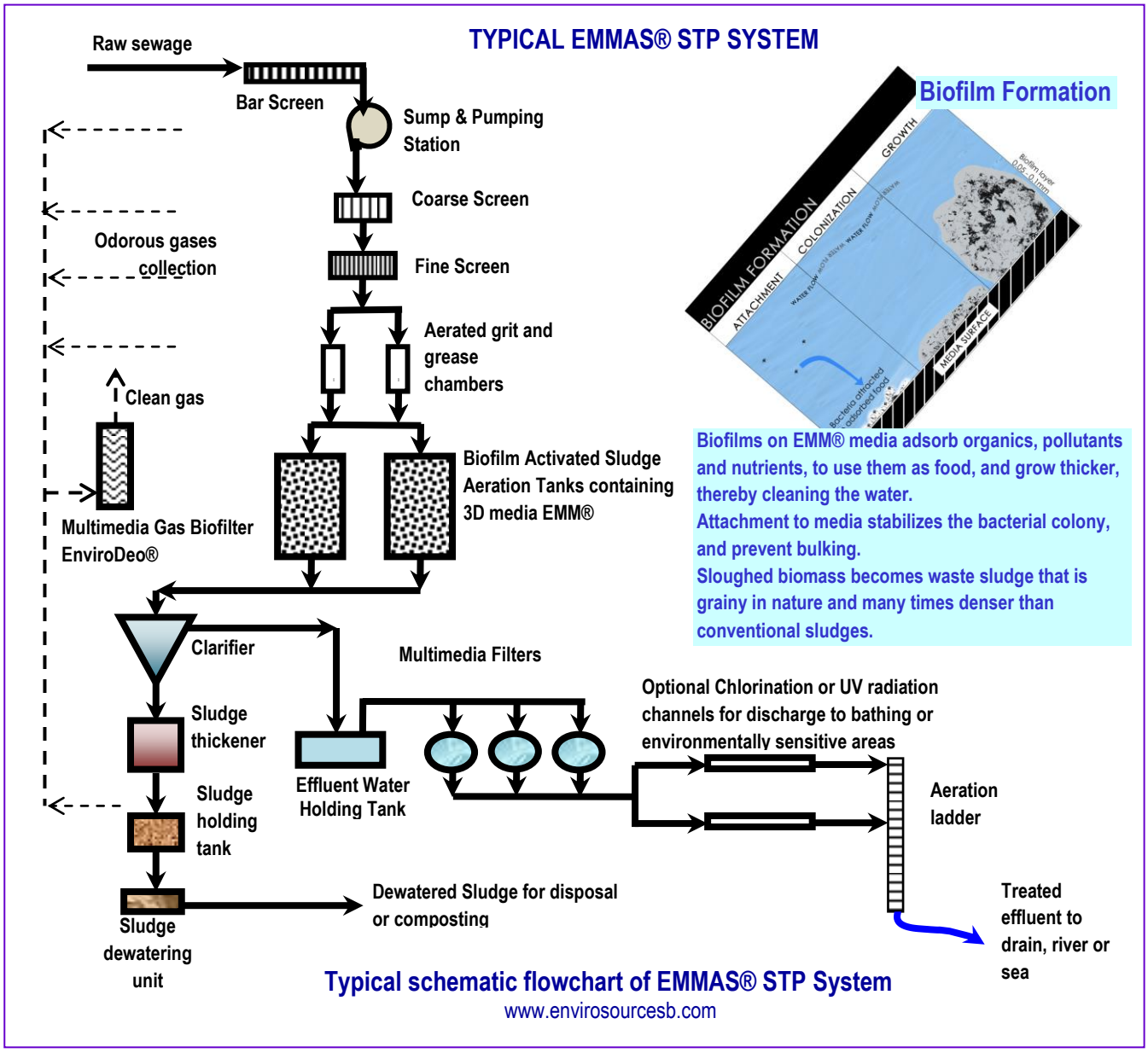
Parameters (units)	Class I	Class IIA	Class IIB	Class III
Ammoniacal-N(mg/L)	0.1	0.3	0.3	0.9
BOD_5 (mg/L)	1	3	3	6
COD (mg/L)	10	25	25	50
DO (mg/l)	7	5 – 7	5 – 7	3 – 5
pH	6.5 - 8.5	6 – 9	6 – 9	5 – 9
Colour (TCU)	15	150	150	-
Cond.#(mmhos/cm)	1,000	1,000	-	-
Floatables	N	N	N	-
Odour	N	N	N	-
Salinity# ($^0/_{00}$)	0.5	1	-	-
Taste	N	N	N	-
Total Diss. Solid (mg/L)	5000	1,000	-	-
Total SS (mg/L)	25	50	50	150
Temperature (°C)	-	Norm+2	-	Norm+2
Turbidity (NTU)	5	50	50	-
E. Coli+ (MPN/100ml)	10	100	400	5,000

STP Design Philosophy

To achieve clean water of Class II as in Table 1, the most challenging is ammonia-N removal. The STP to yield low ammonia-nitrogen should be easy to operate, economical and low in energy requirement. The main objectives of this sewage treatment are: to remove SS, organics, nutrients and pathogens from sewage, down to low, harmless levels, using reliable technologies at sustainable costs. Comparing the performances, requirements and complexities of different STP processes, the biofilm activated sludge (AS) process is the most appropriate for this as it is compact, with high biomass concentrations and yield denser (grainy) sludges. The Envirosource biofilm AS process is the EMMAS® process or the EMM® media Activated Sludge process. It is the same as a conventional AS process, except it has biofilm media in the aeration tank, freely moving as in an MBBR tank. An example of process flow for EMMAS® STP is shown schematically below.

As the only difference between an EMMAS® process and the conventional AS process is the media for biomass attachment employed in the aeration tank, any STP aeration tank may be easily and economically upgraded by addition of media EMM®. The EMM® is a 3D media that protects biomass from being scoured

off by the vigorous aeration in an aeration tank. With media for biofilm attachment, biomass concentration in the aeration tank is greatly increased and prevented from washout, greatly increasing aeration tank efficiency with respect to removal of COD, N and P, at relatively shorter retention times. The sludges generated are grainy, thus much more compact and readily settles. Grainy sludges dewater more easily, cutting down on flocculant cost and disposal costs.

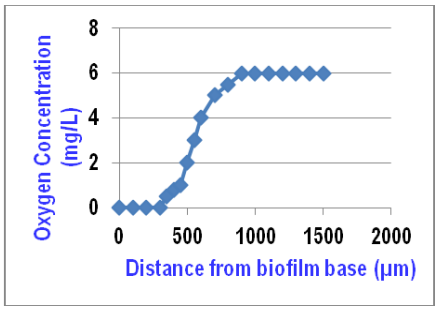


Without attached biofilms conventional systems are limited to only about 2000-2500 mg/L suspended biomass concentrations in the mixed liquor, as higher concentrations would lead to biomass outflow and overloading of clarifier, leading to higher SS in the effluent. With biofilms on moving media (moving bed) the mixed liquor biomass concentration may be maintained at much higher levels, up to 8,000 mg/L or higher, without SS problems in effluent, due to attachment and denser sludges. Besides enabling treatment at

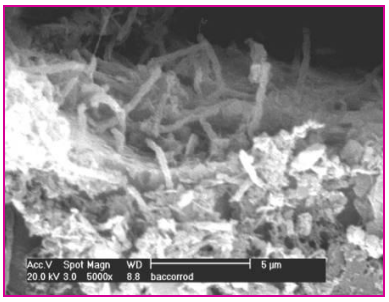
shorter residence times, thus in smaller aeration tanks and lowering energy consumption, the system has added benefits of biodegradation of recalcitrant organics and removal of nutrients.

What gives the high treatment capabilities of EMMAS® biofilm STP?

Oxygen profile in biofilm layers enable survival of anaerobic, anoxic and aerobic microorganisms in one system, rendering the system capable of both oxidative and reductive reactions, such as nitrification and denitrification, thus the high water polishing capabilities.



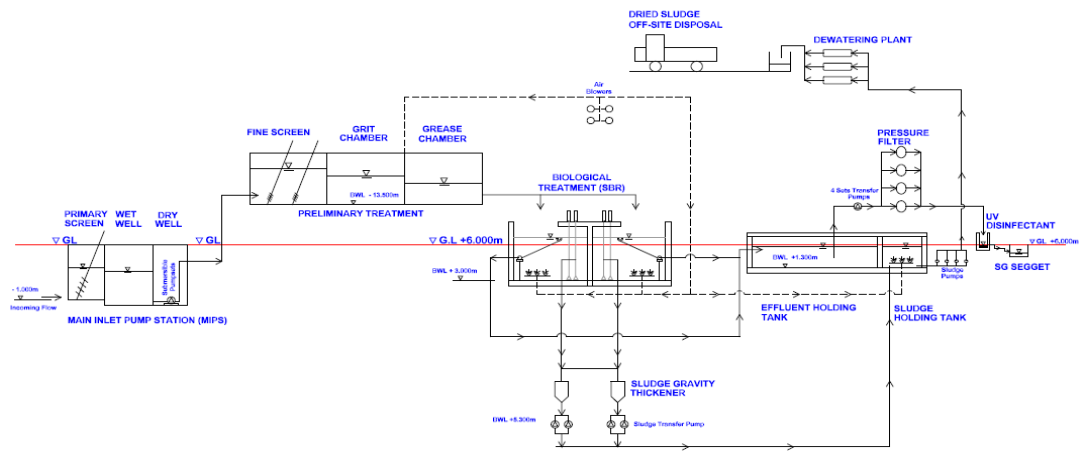
Oxygen profile in biofilm layers, giving anaerobic, anoxic and aerobic conditions in one system, enabling breakdown of a large range of trace pollutants from nutrients to detergents to colouring matters.



Biofilm layer on EMM® media magnified 5,000X using electron microscope.

Operating an STP can be quite costly in terms of energy, mainly due to electricity requirements, thus the EMMAS® STP has been designed to minimize operational costs by:

- **Minimizing O_2 loss from aeration tank by using EMM® media for biofilm attachment. The media minimizes air loss and discharge of aerosols to the air, an inherent danger of conventional aerated systems located in built-up areas. This also minimizes odour, if any.**
- **Using EMM® media which has been designed to have about the same density as water, thereby is buoyed by water, preventing blockages. Media is robust built PP/HDPE and lasts a lifetime.**
- **Maximizing floc stability by using attached growth system, thus reducing sludge volume via granular sludges; activated sludge floc generally has a density of about 1.02 g/ml, whereas biofilm sludge has density of about 3 g/ml or greater.**



Shown here is an STP using the EMMAS system to maintain receiving river water at Class II of the NWQS as in Table 2 above.

ENQUIRIES

For information on appropriate treatment system for your effluent, industrial or domestic, and quotation, please email us giving your project's info (effluent characteristics, flowrate, schedule, etc.) to: technical@envirosourcesb.com