



syntekenvironmental
industrial wastewater treatment and reuse

TECHNICAL CASE STUDY

Ecosynergy® system application in treatment of wastewater from Corrugated Cardboard Product Manufacturer

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Type of industry

The Ecosynergy® bio-engineering treatment process is being applied at several corrugated cardboard product manufacturers. These plants typically manufacture cardboard boxes for packaging of agricultural produce, food, drinks etc. In corrugated cardboard manufacture cardboard liner boards are glued to a corrugated cardboard fluting to make a strong walled packaging material. The corrugated board is preprinted by a flexographic process and cut, folded and glued into the form of a cardboard box. The effluent from these plants is generally coloured black from washing the flexographic ink off the printing presses. Black ink is largely based on carbon black dispersed in either hydrocarbon oil or soybean oil. The carbon black cannot be degraded but the oils tend to emulsify during wastewater treatment. Heavy metals are also present in the wastewater from coloured inks. The starch based glue used to glue the fluting to the liner boards also contributes COD to the wastewater and may contribute odour on degradation.

Pre-existing treatment process

Before the introduction of the Ecosynergy® system the wastewater was typically treated by flow balance, coagulant and polymer dosing and dissolved air flotation. The sludge generated from the DAF unit was dewatered by a filter press. In some cases a batch treatment system is used instead of a DAF unit.

Problems need to be solved

Inconsistent effluent quality: parameters exceeding discharge limits, such as ammonia (NH₃-N); barium (Ba); and total suspended solids (TSS).

High sludge volume.

High cost of sludge disposal as most ink waste sludge is classified as restricted industrial solids or hazardous solids waste.

Chemical usage and high cost.

What is Ecosynergy® process

The Ecosynergy® system has been developed with the aim of reducing capital costs and space restraints when a biological treatment application is required in treatment of industrial wastewater. It is based on the concept of simulation of the natural bacterial ecosystems so that synergistic interactions are formed between the species in the population. The degradation of organic and some inorganic compounds can be enhanced where selected specialized bacteria, or bacteria as plasmid donors for degradative pathways, are added. The system is designed to provide a growth environment under aerobic and anaerobic conditions. Further enhancements to water quality are also achieved by the application of a natural coagulant and various novel membrane filtration systems.

How Ecosynergy® process is applied

Initial investigation to solve the plant problems required laboratory scale bench trials of the various synergistic bacteria combinations in aerated samples of plant wastewater. From the lab trials appropriate bacterial consortia were chosen for plant trials. Process analysis was then carried out to determine the best points to add the bacteria into the system. This analysis consisted mainly of determining retention times in various stages of the process and determination of effective aeration, mixing and temperature regimes. No major modifications were made to the existing layout except for the introduction of aeration discs in the balance tank and the discontinuation of unnecessary chemical dosing.

Achieved outcomes

After the introduction of the Ecosynergy® system there was a significant reduction in sludge volume. The system was much more able to cope with inconsistent flow rates and changing solids loadings due to the consideration given to retention times, multiple dosing points and dosing levels. The effluent had greater water quality meeting all water board discharge limits to the sewer.

Odour Reduction

Odor generated by fermented starch and degraded ink and around drainage pits and wastewater treatment area has been controlled immediately after the application of synergistic bacteria.

Sludge Reduction

Sludge reduction is achieved by using specifically formulated synergistic bacteria rapidly digesting the solids (ink and starch) in the wastewater.



(a) raw water sample



(b) after 30 hour biological treatment

The level of sludge reduction is normally in order of 40-50% when the synergy bacteria system is applied directly into the existing treatment system. With addition of longer retention time, the sludge reduction rate will increase to over 80%. The solids classification will be downgraded depending on the reaction time allowed for the synergistic bacteria to digest the hydrocarbons and metals in the sludge.

The solids classification for disposal is changed after applying the biological treatment.

Historical solids analysis results for selected metals and hydrocarbons:

Date	Mo (mg/kg)	Zn (mg/kg)	Pb (mg/kg)	TPH C10-14 (mg/kg)	TPH C15-28 (mg/kg)
26-Aug-08	89	110	2	10000	6500
28-Aug-08	66	110	3	5700	14000
4-Sep-08	51	92	2	8200	8800
10-Sep-08	69	900	7	8500	7700
7-Oct-08	54	130	17	2700	8000
14-Oct-08	130	230	61	2700	6400

After implementing the Ecosynergy® system in-situ the sludge waste classification was downgraded from hazardous to industrial solids, as shown in table below:

Date	TPH C10-14 (mg/kg)	TPH C15-28 (mg/kg)	TPH C29-36 (mg/kg)
12-Nov-08	4000	2300	390

Improved water quality

At limited retention time of around 18-22 hours, the effluent quality has improved with concentrations of all concerned parameters consistently meeting the water board effluent discharge limits.

Historical discharged water analysis results:

Day	Date	Discharge (kL)	Ba (ppm)	Cu (ppm)	SS (ppm)	BOD (ppm)
Friday	29-Aug-08	107	0.81	0.15	35	190
Friday	5-Sep-08	108	1.1	0.09	26	270
Saturday	6-Sep-08	103	1.1	0.17	58	160
Tuesday	9-Sep-08	83	1	0.22	58	300
Thursday	11-Sep-08	104	1.9	0.4	64	230
Tuesday	16-Sep-08	109	1.4	0.07	58	400
Tuesday	23-Sep-08	50	4.9	3.5	7	760
Thursday	25-Sep-08	88	2.1	0.36	120	510
Friday	3-Oct-08	74	2.4	0.3	47	410
Thursday	9-Oct-08	114	2.1	0.38	100	430
Tuesday	14-Oct-08	86	2.1	0.9	270	530
Friday	17-Oct-08	117	25	1.2	190	590
Tuesday	21-Oct-08	62	43	2.2	420	880

After implementing the Ecosynergy™ system in-situ:

parameter	concentration	MDM limit (kg)	Mass discharged (kg)
Oil and grease (mg/L)	7	4.73	0.86
Sulphate (mg/L)	10	82.04	1.23
Barium (mg/L)	0.4	0.32	0.05
Copper (mg/L)	0.14	0.44	0.02
TSS (mg/L)	18	95	2.21
BOD (mg/L)	63	144.66	7.73

Chemical usage reduction

As the Synergy biological treatment acts as a natural coagulation process, the usage of normally applied metal based coagulant can be reduced after 1-2 weeks of application of synergistic bacteria.

“Natural floc,” developed using gel type material derived from natural products blended with synthetic organic product, was used to replace the conventional coagulant and polymer mixture, and further reduced the sludge volume by 30-40%.

The use of “Natural floc” in lieu of metal based coagulant and polymer (usually cationic based) has the following benefits;

- 1) Cost reduction.
- 2) Sludge volume reduction by 30%.
- 3) Minimising membrane fouling in downstream membrane plant for reuse.
- 4) Reduced hydrocarbon concentration in sludge.

Operating costs reduction

By implementing the synergistic bacteria control system, using the naturally derived chemicals the total operating cost for wastewater treatment has reduced by over 50% at all sites.

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