

## CASE STUDY – TREATABILITY STUDY: WASTE WATER TREATMENT PLANT FOR PEMEX OIL REFINERY – SALAMANCA, MEXICO

### THE PROBLEM

Both PEMEX and the City of Salamanca were looking at constructing two sewage treatment plants to treat wastewater; one to treat the Ing. Antonio M Amor refinery's industrial waste and one to treat the City's municipal waste. Based on the successful performance of Nordevco's technology in remediating contaminated wash water at the decommissioning of the PEMEX La Nogalera petroleum storage facility in Guadalajara, Nordevco was commissioned to conduct a treatability study of its capability to treat both the refinery wastewater and the municipal waste water.

### OUR APPROACH

Based on a review of the two waste streams, Nordevco's technical staff determined that the most effective solution would be to treat both waste streams in one facility. To demonstrate that capability, the Consorcio Quimico de Toluca in Toluca, Mexico, an independent laboratory, was commissioned to carry out treatability studies to evaluate the effectiveness of the Nordevco technology. To model a sewage treatment system, a three chamber system was constructed: a 12 liter waste storage tank, 9 liter aeration tank and a 4.5 liter sedimentation tank. Nordevco technical staff designed a series of three tests to assess the effectiveness of the *BactiDomus*<sup>TM</sup> Delivery Technology to treat refinery waste, a mixed waste stream (57% refinery waste and 43% Salamanca municipal waste) and a final test to compare the *BactiDomus*<sup>TM</sup> Delivery Technology's effectiveness to treat the mixed waste to a treatment with activated sludge from a wastewater treatment plant.

### TECHNOLOGY

The *BactiDomus*<sup>TM</sup> Delivery Technology is the next generation approach to bioremediation and its development focused on eliminating the problems associated with traditional bioremediation (bioaugmentation and enzyme applications). Nordevco developed the *BactiDomus*<sup>TM</sup> Delivery Technology specifically to improve the efficiency, reliability and cost of treatment. What makes the *BactiDomus*<sup>TM</sup> technology unique and significantly more effective is the 'delivery system' that focuses on getting the appropriate bacteria to the contaminant and ensuring that those organisms have a support environment to allow them to thrive.

At the core of the *BactiDomus*<sup>TM</sup> Delivery Technology is the unique carrier material that the delivery technology is built on. This carrier material is a naturally occurring and non-toxic inorganic compound that acts as an all-inclusive module that carries the appropriate bacteria to the contaminant. While the embedded bacteria break down the organic contaminant, the carrier material provides protection from the potentially toxic levels of contaminant, micronutrients and a greater contact area between bacteria and contaminant.

A number of different modules have been created to deal with specific types of contamination. Each different module potentially contains a variety of different organisms selected for their ability to degrade the specific contaminant. Under normal circumstances some strains would be predatory or antagonistic to each other. Because each strain is 'housed' in a different capillary they are unable to attack each other. This allows us to select the most effective bacteria for a specific treatment rather than any single strain.

Specifically, the *BactiDomus*<sup>TM</sup> technology bonds the specifically selected microorganisms to the capillaries of the carrier material. In addition, nutrients and trace elements are added. This process provides a number of advantages over traditional approaches including:

- Creating a complete environment for the microorganisms that increases both their survivability and efficiency and reduced early organism mortality
- Providing initial nutrient requirements for rapid organism activation
- Providing protection against the toxic effects of the environment in which they are employed
- Provides a support system that increases and optimizes the contact surface between the bacteria and the contaminant
- Allows for combining a variety of different bacteria that would normally be predatory to each other into one delivery system as each strain is isolated from the other by the carrier material which in turn provides for a greater range of successful contaminant treatment
- Increasing bacteria survivability and longevity increases the duration between applications reducing the costs of the treatment.

## THE RESULTS

### TEST 1: TREATMENT OF A MIXED WASTE WATER SAMPLE, USING NORDEVCO ASSOCIATES TECHNOLOGY

Parameter	Retention Time: 6 hours			Retention Time: 8 hours			Retention Time: 12 hours			Standard	
	Influent (mg/l)	Effluent (mg/l)	Removal Efficiency (%)	Influent (mg/l)	Effluent (mg/l)	Removal Efficiency (%)	Influent (mg/l)	Effluent (mg/l)	Removal Efficiency (%)	SEDUE	EPA
BOD5	235	28	88	252	26	90	269	25	91	60	26
COD	484	76	81	456	66	85	508	55	89	100	100
SS	197	30	85	210	28	87	222	27	88	70	21
VSS	113	38	-	125	38	-	136	38	-	-	-
D.O.	-	-	-	-	-	-	-	-	-	-	-
pH	7.2	7.2	-	7.31	7.29	-	7.41	7.38	-	6-9	6 - 9
N	23	5	-	24	5.5	-	24	6	-	-	-
PO4	14.9	2.8	-	14.1	2.8	-	13.2	-	-	-	-
Phenoles	0.1	0.005	93	0.25	0.003	94	0.4	0.002	95	-	-
Grease and Oil	109.2	11.1	90	108.2	8.7	92	107.8	6.4	94	40	8

The Nordevco *BactiDomus*<sup>TM</sup> Delivery Technology was able to treat the mixed waste (57% refinery waste and 43% municipal waste) and meet all SEDUE (Mexican Environmental Standards) standards within six hours and the EPA standards for BOD<sub>5</sub>, COD and pH. Within twelve hours, the EPA standard for oil and grease was also met.

**TEST 2: TREATMENT OF REFINERY WASTE WATER USING NORDEVCO ASSOCIATES TECHNOLOGY**

Retention Time: 6 hours

Parameter	Influent (mg/L)	Effluent (mg/L)	Removal Efficiency (%)	Standards	
				SEDUE	EPA
BOD5	243	47.9	80	60	26
COD	531	96.1	82	100	100
SS	98	25.6	74	70	21
VSS	90	-	-	-	-
D.O.	-	-	-	-	-
pH	8.71	7.61	-	6 - 9	6 - 9
N	20	-	-	-	-
PO4	0.2	-	-	-	-
Phenoles	3.91	1.36	65	-	-
Grease and Oil	138	18.31	87	40	8

The Nordevco *BactiDomus*<sup>TM</sup> Delivery Technology was able to treat the refinery waste) and meet all SEDUE (Mexican Environmental Standards) standards within six hours and the EPA standards for BOD<sub>5</sub>, COD and pH.

**TEST 3: COMPARISON OF NORDEVCO ASSOCIATES TECHNOLOGY TO NATURAL BACTERIAL FOR TREATMENT OF MIXED WASTEWATER**

Parameter	Nordevco Technology			Natural Bacteria	
	Influent (mg/l)	Effluent (mg/l)	Removal Efficiency (%)	Retention Time: 24 hours	
				Effluent (mg/l)	Removal Efficiency (%)
BOD <sub>5</sub>	235	28	88	66	72
COD	404	76	81	117	71
SS	197	30	85	-	-
VSS	113	38	-	-	-
D.O.	-	-	-	-	-
pH	7.2	7.2	-	7.41	-
N	23	5	-	-	-
PO <sub>4</sub>	14.9	2.8	-	-	-
Phenoles	0.1	0.005	93	-	-
Grease and Oil	109.2	11.1	90	20	82

The Nordevco *BactiDomus*<sup>TM</sup> Delivery Technology was more efficient in treating the mixed waste (57% refinery waste and 43% municipal waste) than the activated sludge. Nordevco's technology was able to achieve an approximately 11% greater removal efficiency rate in six hours than the activate sludge was able to achieve in 24 hours.