


Bio-Methanation

How can it help an ethanol plant's bottom line?

By reclaiming and recycling process water, the ICM/Phoenix Bio-Systems Bio-Methanator™:

- Speeds the plant's recovery process following infections and ensures maximum alcohol concentration at fermentation finish by reducing organic acids that inhibit yeast growth
- Improves water efficiency by recycling water
- Improves energy efficiency by generating methane to replace a portion of natural gas needs

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Adding value with a Bio-Methanator™ - An example case

The ICM/Phoenix Bio-Systems Bio-Methanator™, a patented anaerobic digestion technology, is an important element in ICM's ethanol process technology package because of the critical functions it performs in stabilizing yield and conserving resources.

Since our very first plant was designed in 2001, ICM has employed a Bio-Methanator™ in more than 100 ethanol facilities to reclaim and recycle condensate that has been in contact with process liquids during the syrup evaporation process. The condensate, which contains acetic acid and other volatile organic chemicals, is not suitable for return to the boiler. If not recycled, it would present challenges for discharge, along with reducing energy efficiency and increasing water use.

Relied upon as the exclusive choice for organic water treatment in ICM-designed plants, the Bio-Methanator™ is now available for use in facilities that incorporate other process technology.

A well-controlled environment delivers optimum fermentation results

Even at low concentrations, organic acids, including acetic acid, are known to adversely affect the growth of yeast. These acids are produced at low levels naturally during the fermentation process by microorganisms that compete with the yeast for available nutrients.

When fermenter infections occur, these competing organisms reproduce at a faster rate than the yeast, leading to elevated organic acid concentrations. At levels as low as 0.05% w/v[1], acetic acid can adversely affect the growth of yeast. Acetic acid is also a contributing factor to yeast stress, which can ultimately reduce the final maximum alcohol concentration at the finish of a fermentation cycle.

A Bio-Methanator™ enables the plant to reduce the acetic acid buildup that, otherwise, would be recycled to subsequent fermentations, potentially reducing ethanol yields for multiple batches. With a Bio-Methanator™, plants are able to recover from infections much more quickly, by almost immediately reducing acetic acid to normal background levels.

In *The Alcohol Textbook* (2003), W. M. Ingledew uses operating plant data to illustrate the effects of high organic acid levels on post-fermentation alcohol levels as compared to controlled normal conditions. His results are illustrated in Table 1, below.

Table 1: Effect of Acid Levels on Fermentation Yields

Tank no.	Ethanol (%w/v)	Glucose (%w/v)	Lactic Acid (%w/v)	Acetic Acid (%w/v)	Ethanol Loss (%)
A (Normal Cond.)	12.4	0.03	0.35	0.02	-
B (Normal Cond.)	12.8	0.024	0.29	0.04	-
H (High organic acids)	10.8	4.70	1.00	0.32	14.3
K (High organic acids)	9.5	5.14	1.00	0.41	26.2

Operating plant data demonstrates the effects of organic acids on batch fermentations.

Assigning dollar values to data shows potential cash generation

Expanding on this data by assigning present-day dollar values to the variables that affect your plant's bottom line (including ethanol price, DDG price, and energy) allows us to estimate the incremental revenue recovery your plant can achieve through the installation of a Bio-Methanator™.

While the Bio-Methanator™ cannot prevent infections, it can reduce their economic impact and help a plant get back to normal operating conditions faster, which can translate to increased plant revenue. The ICM/Phoenix Bio-Systems Bio-Methanator™ can be retrofitted into non-ICM-designed plants to provide this same level of insurance against the negative effects of infections. This equipment also produces increasingly valuable bio-gas. The installation of a Bio-Methanator™ may be eligible for government funding assistance as a renewable energy system.

Find out more

Contact us today to determine if this ICM technology might be a fit for your process.

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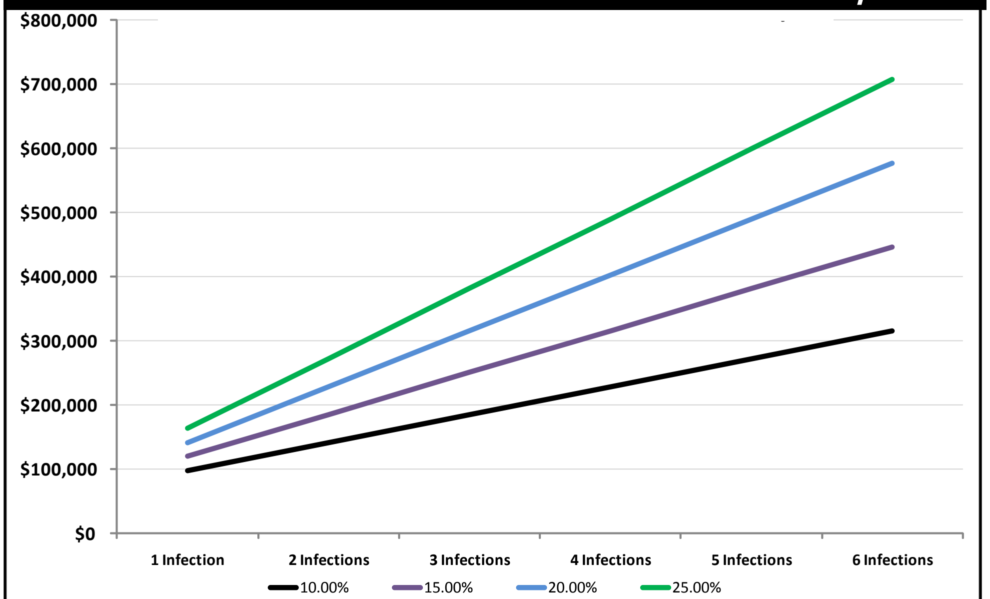
Yield loss has been estimated based on acetic acid level reductions for subsequent fermentations utilizing the data in Table 2.

Table 2: Acetic wt % in each subsequent fermentation batch

Cycle	1	2	3	4	5	6
100% Bio-Methanator™	7.00%	4.35%	3.46%	3.16%	3.06%	3.03%
No Bio-Methanator™	7.00%	5.90%	5.29%	4.94%	4.75%	4.65%

Chart 1: Incremental Revenue Recovery per Infection at Ethanol % Loss with Bio-Methanator™ Installation for 100 MGPY Ethanol Facility



% Ethanol Loss per Fermentation	1 Infection	2 Infections	3 Infections	4 Infections	5 Infections	6 Infections
	Cash Generated: additional ethanol produced, DDG weight loss from sugars converted to ethanol, and cost savings through methane generation					
10.00%	$98,549	$142,098	$185,647	$229,196	$272,745	$316,295
15.00%	$120,324	$185,647	$250,971	$316,295	$381,618	$446,942
20.00%	$142,098	$229,196	$316,295	$403,393	$490,491	$577,589
25.00%	$163,873	$272,745	$381,618	$490,491	$599,364	$708,236

Chart 1 assumes that typical background acetic acid levels are 2.0% w/v; 4.0% w/v is considered inhibitory; and 7.0% w/v is the typical acetic acid spike level following an infection.

1. Ingledew, W. M. (2003). Water reuse in fuel ethanol plants: effect on fermentation. Is a 'zero-discharge' concept attainable? *The Alcohol Textbook 4th ed.* (pp. 24, 352). Nottingham, UK: Nottingham University Press.

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