BIOFILTERS

THEIR USE AND COST IN THE RENDERING INDUSTRY

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The purpose of this article is to provide information concerning the use of biofilters in the rendering industry, conditions that affect their performance, and the costs associated with their use. Biofilters utilize bacterial cultures contained within a moist media to remove odiferous compounds captured in the water from out of the air stream. They are prone to the same limitations as are waste water treatment systems utilizing active aerobic bacterial cultures.

Biofilters normally represent a high up-front capital investment (normally between $80 and $200 thousand), followed by annual maintenance costs of between $20 and $60 thousand (on average). Biofilter systems also require a large supply of water, both for cooling and for maintaining moisture in the media.

Because biofilters are comprised of bacterial cultures, let us cover some bacteria basics. Bacteria, or bugs as they are sometimes referred, like the following: constant food concentrations, constant temperatures, and adequate water. Bacterial media contains a variety of bacterial types. Each type of bacteria likes a certain type of material as food. Some utilize mercaptan/thiols and some metabolize ammonia or amines. In every application colonies adjust their population size to match the available food in the water and shift the dominant type of bacteria depending on the type and quantity of available food, temperature and pH. (They match their population ratio to the ratio of the types of materials in the water. [For example, the ratio of mercaptans to amines.])

Temperature determines which type of bacteria will be dominant. Within biofilters normally we will see either mesophilic or thermophilic organisms, and several varieties within each of these groups.

All "bugs" go through different growth phases. The lag phase is where little or no growth occurs, where the bug metabolism slows down. This lag phase is most likely to occur following changes in media conditions or swings in loading. It can last anywhere from three hours up to two to three days, allowing any excess odor to escape to atmosphere.

The logarithmic phase follows the lag phase and is a period of maximum growth, where the bug population multiplies to match the elevated nutrient levels.

After this period of maximum growth, the bug population goes into a stationary phase. In the stationary phase the number of bugs equals or matched the available food (odiferous compounds). This phase represents optimum odor capture or optimum biofilter performance and should occur regularly under continuous operations.

Finally, the bugs can or will progress into the "decline" phase where the bugs die off, the population decreases to match **lower** food levels. Normally this phase occurs during prolonged rendering plant shutdowns or during major changes in production.

Moisture is of primary consideration. Bacteria cannot survive in the active state without sufficient moisture. Lack of moisture will drive active bacteria into their dormant or spore state. Water serves as the primary solvent for food and all bacteria require water in order to metabolize this food. The percent moisture to the media should be between 50 to 70 percent, with 60 percent being the optimum. Excess water in the media affects the porosity, obstructing the air flow.

Moisture control, temperature control and loading are all interrelated. Ideally, moisture is controlled through pretreatment of the air stream with spray towers, venturi scrubbers, or even complete condenser/scrubber systems. These pretreatment systems ensure saturation of the air stream with moisture, sufficient removal of excess loading prior to the biofilter (biofilters

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work best with low constant levels of odor compounds) and that the temperature is **constantly** controlled within the desired range (temperature is site specific or more importantly "bug" dependent). At elevated media temperatures, contaminants escape into the air or environment. The amount that escapes will depend on both the material and on the temperature (please review the April 1997 edition of *Render*, article entitled "Wet Scrubber Removal of Odors and VOCs" that discusses solubilities and temperatures). Without condensing or adequate pretreatment equipment, loading will vary significantly with production (again, swings in loading effects the quantity of available food and consequently the bug population). As temperatures change, changes in the dominant type of bacteria will occur. If the temperature elevates above 160 degrees Fahrenheit you risk loosing the media culture. If the moisture drops below 50 percent in the media, additional water will need to be added to the media directly (usually with a spray nozzle system). Prolonged periods of low moisture conditions cause the bugs to go into the lag phase, again allowing odor to escape into the atmosphere.

Switching from one type of product to another (pork to chicken, bone to feather) causes shifts in the bug population. As the bugs change their population ratio to match the new compounds, there will be periods of time where minimum odor capture occurs.

With time an accumulation of reaction by-products occurs. These reaction by-products may be nitrates, nitrites, sulfates, ammonia, and sulfuric acid, among other things. Some of these materials will drive the pH of the media high or low. Excess levels of reaction by-products can inhibit bacterial growth. (Bacteria like neutral to slightly alkaline conditions.)

Media material degrades with time. This degradation is increased as the levels of reaction by-products increases. As the media degrades, media compaction occurs followed by a loss in air flow and increased energy costs.

Poisoning of the biofilter can occur either through the air stream or through the water. Oxidizing biocides in the air stream can speed the degradation of the media and kill the bacteria. Metal, synthetic material, or oxidizer contamination can kill the bugs from the water side.

Biofilter performance then is affected by the following conditions: insufficient or excessive moisture, excessive load swings, change in temperatures, elevated temperatures, solubility, change in load types, pH swings, poisons, media compaction, media degradation, and reaction by-product accumulation.

Biofilters are ideal in applications where the type and quantity of material cooked remains constant (continuous operations) and adequate pretreatment equipment is employed to assure moisture and temperature control (the bugs perform at optimum if you give them what they want). Cost performances will vary from site to site depending on the type of media, bug populations, installation costs, water and energy costs.

APPI Correction

The following companies were inadvertantly left off the Animal Protein Producers Industry (APPI) Salmonella Testing Program's 1996 participant list reported in the June issue of *Render*. We apologize for any inconvenience this may have caused.

COMPANY NAME
LOCATION

West Coast Reduction
Vancouver, B.C., Canada
West Coast Rendering
Vernon, CA
Western Mass. Rendering
Southwick, MA
Wilbur-Ellis Co.
Portland, OR
Worthington Rendering
Worthington, MN
Yalco Processing Co.
Water Valley, MS ***

NOTE:
** Plants who have previously participated in the program but did not participate in Summer 1995.
*** First time participants. (16 plants)

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