RAPID DETECTION OF PATHOGENS AND CONTAMINATION BY ANALYSIS OF BIOFILMS GENERATED IN BIO-SEP® BEADS: IMPLICATIONS FOR MONITORING WATERSHEDS IMPACTED BY CONFINED-ANIMAL FEEDING OPERATIONS

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The major problem with protecting water is the great dilution of potential pathogens and toxicants. Our solution to this monitoring problem is to utilize the propensity of microbes and toxicants to concentrate at surfaces in biofilms. Biofilms, as entities, are localized microbial communities attached to surfaces. Biofilms are major sources of infection in water distribution systems. Microbes, in nature, prefer to exist in multi-species community biofilms rather than be free in fluids. A logical, cost-effective, method to sample pathogenic microbes and membrane-active toxicants in water is to recover biofilms from strategically placed surfaces. We propose a two-tiered system with a network of reporting biosensors and associated specific bio-trap biofilm capture/amplification beads that can be recovered for rapid specific biomarker and agent analysis. Both biosensors and bio-traps with amplifying beads would be placed at strategic nodes in the watershed collection and distribution system for monitoring to provide feedback to purification and interdiction systems, to protect drinking water in the rest of the system. Nodes would be outfitted with biosensors reporting changes in general biofilms and with biosensor, surfaces can be engineered with specificity. A change in biofilm formation at a node would signal recovery of bio-traps containing mixed surface Bio-Sep® beads designed with accumulation specificity for biofilms and toxic agents. Organisms in these biofilms would be rapidly analyzed for signature lipid biomarkers with tandem mass spectrometry. Biomarkers indicative of pathogens or toxins would in turn trigger real-time PCR rapid DNA analysis for specific identification of agents and toxins. Contamination at specific strategically placed nodes in the collection/distribution system could then be utilized to manipulate flows to best protect the users. The instrumented system based on maximizing protection of the users could be readily upgraded with improvements in specific biosensor technology and rapid specific detection of biomarkers from the bio-trap beads.

Key words: biofilms, biosensors, biotrap beads, pathogens