Cationic polymer and high-speed centrifugation effects on pathogen reduction during manure solid/liquid separation

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Most environmental studies concerning manure management focused on the effects of nutrients recovery and water quality but the microbial quality/quantity of animal manure should not be neglected. Animal manure is an obvious source of pathogens; the recycled water from manure can potentially cause disease outbreaks in both animal herds and humans unless the manure is handled appropriately. Many outbreaks of gastroenteritis related to livestock operations have been reported. Currently, anaerobic digestion and composting are the most accepted methods of pathogen reduction for high strength municipal sewage and animal wastes. However, few researches have been found to investigate the biocidal efficacy of the polymers when they are used for solid/liquid separation. There is also a lack of comprehensive study about the effect of high-speed centrifuge (up to 10,000×g) on pathogen and solids reduction as well as the interaction between the solids content and pathogen densities. Opportunities exist for further manure pathogen reduction using high charge cationic polymer and high speed centrifuge for during manure solid/liquid separation.

In this study, polymers effects on pathogen reduction were investigated. Low charge density cationic polyacrylamide (CPAM) was selected because CPAM has been commonly used in manure treatment and it is effective for manure coagulation and flocculation. The effect on pathogen reduction of CPAM was studied in this research. High charge density cationic polydicyandiamide (PDCD) was selected because of its application of water clarification and its the extreme high charge. A series of experiments of each polymer in high nutrient and low nutrient conditions were conducted to study the solids separation and pathogen reduction mechanisms as well as to optimize the polymer dosage for on-farm application. This study demonstrated that although CPAM is effective for manure coagulation and flocculation, it has a negligible effect on pathogen reduction. In contrast, PDCD is not effective at coagulating dairy manure at its typical solids content, but has a positive impact on pathogen reduction (Fig. 1.) Moreover, PDCD could further reduce the manure pathogen density and solids content in the low solids portion of manure following CPAM separation.

Physical and chemical treatments are available for concentrating solids and nutrients, and widely applied in animal waste and biosolids treatments. Centrifugation, a commonly used dairy manure separation method, has been shown in the literature to not significantly reduce pathogen levels. In contrast, lab scale centrifugation experiments have shown that pathogens in manure liquid could be reduced significantly. One possible reason is that, for the consideration of economic performance, large scale centrifuges usually have a lower centrifuge speed because of the high energy cost and a shorter retention

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time due to high volumetric feed rate. In addition, microbiologists often use high speed centrifugation to harvest planktonic bacteria as a common laboratory practice. A wide variety of forces ranging from 1,000 to 12,000×g are used for bacteria harvesting purposes. Therefore, the motivation for this study was raised to investigate the centrifugal force on pathogen removal from the liquid fraction in dairy manure. In this section of our work, *E. coli* and total coliform counts were examined under three different conditions: buffer media only samples, dairy manure samples and polymer amended dairy manure samples. For each condition, the samples were centrifuged at a series of speed from 0×*g* to 10,000×*g*. The results demonstrated that high-speed centrifugation was capable of reducing pathogen levels in the liquid portion of the manure, with pathogen reductions as high as 99% from a single separation process (Fig. 2), though at speeds much higher than typical industrial centrifuges.

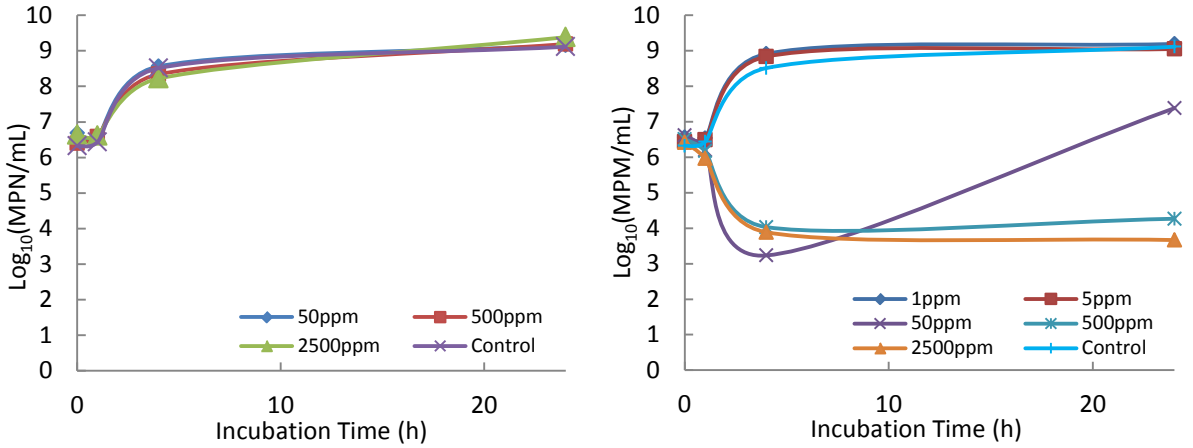

Fig. 1 *E. coli* densities in dilution buffer with CPAM (left) and PDCD (right) added

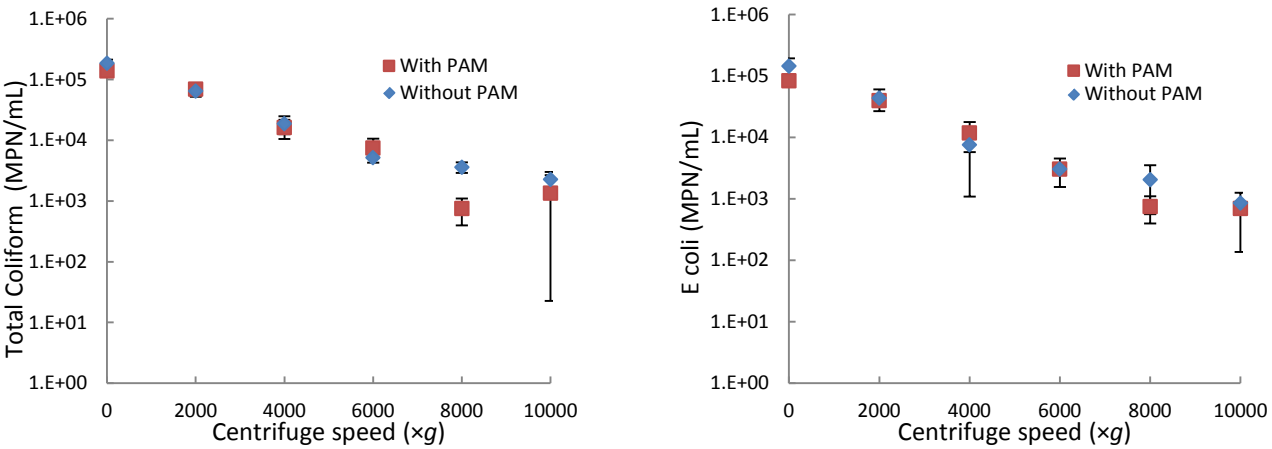

Fig. 2 Total coliform (left) and *E. coli* (right) reduction with centrifuge speed