

MICROBIAL CONTAMINATION OF WATER ACTION TEAM

PROGRESS REPORT

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Environmental Problem: Although current regulations have significantly decreased waterborne disease outbreaks, pathogens continue to contaminate drinking water supplies causing public health concerns. The CDC estimates that pathogen infected drinking water results in approximately one million new cases of illness and one thousand deaths annually.

EPA currently regulates two indicators of microbiological drinking water quality: total coliform and turbidity. Challenges of using indicator organisms for monitoring water quality are: (1) Poor correlation between indicators and the presences of pathogens (because there is a great diversity of microbial pathogens); and (2) Long delay in obtaining results thereby causing a time lag between the occurrence of the contamination event and its detection to be able to safe guard consumer health.

Therefore, “rapid” or “near real-time” quantitative analytical methods are needed that can specifically detect a broad array of microorganisms.

Priority Project. Application of molecular technologies to source and potable water monitoring

Technology Challenge:

1. Development of Molecular Detection Technology for Monitoring Water

Molecular detection technologies have the potential to detect multiple pathogens in a single analysis, to make highly specific identifications, and to detect very low numbers of target organisms rapidly. Although a considerable amount of work has been done to develop rapid, sensitive, and quantitative molecular methods, several challenges remain that must be resolved before EPA will approve these methods under existing or new regulations. For example, one important challenge is the development of sample concentration methods, prior to water analysis, that reliably provide the needed

sensitivity for detecting the low number of pathogens that may be present in water samples.

2. Comparison of Molecular Detection Technologies to Existing Methods

Existing methods are based on the detection of culturable indicator organisms. Results from molecular methods must be correlated to the existing methods for detection of viable organisms. Additionally, molecular methods must have equal or greater detection sensitivity to indicator bacteria methods (1 per 100 mL). Molecular methods must also be able to detect specific pathogens, a characteristic which existing indicator methods lack, including non-culturable pathogens.

3. Acceptance of Molecular Methods

The water industry has used existing indicator bacteria methods for approximately 100 years. To gain acceptance, molecular methods must satisfactorily demonstrate that they provide useful data on pathogens that have the same or greater predictive value as methods for indicator organisms.

The mission of the action team will be to (1) identify innovative technologies that demonstrate the greatest potential for environmental application (2) identify research gaps in adapting molecular technologies for consideration by ORD's Research Program, including the STAR and SBIR Extramural Programs, and AWWARF (3) provide technical support for the expansion of methods and (4) quantify economic and environmental benefits for the use of these methods.

FY'08 Accomplishments:

1. The focus group planned and prepared a poster to present at the 2008 EPA Science Forum. The poster was well received and caught the attention of the Journal 'Environmental Science and Technology'
2. The focus group met several times to present a proposal for a workshop at the upcoming Water Quality Technology Conference to be held in Cincinnati, Ohio in November 2008. This workshop has been accepted by the organizers and involves a day long hands-on seminar that introduces qPCR methods to water utility and other personal interested in testing environmental waters. Besides the focus group members, we have been able to get a number of scientists from ORD to commit to teach at this workshop. The workshop, if successful, will be a step forward in the use and acceptance of these methods by the water community.

General accomplishments:

FY'08 Plan:

- Compile a list of EPA funded projects that utilize molecular technologies to detect waterborne pathogens in environmental samples- To be completed by September 2008
- Perform market research of vendors selling the various consumables, reagents and instrumentation needed for the above mentioned technologies-To be completed by December , 2008
- Provide technical support for these methods
- Plan a hands-on qPCR workshop for water utility personnel and others, at WQTC, November, 2008
- Quantify economic and environmental benefits for the use of molecular methods. To be completed by September, 2008

Current Funding and Additional Resources Required: Funding in the range \$15K needed for contractor support for a report on economic and environmental benefits for the use of molecular methods. Funding has been requested from OW, EPA and NERL and NRMRL, ORD

Issues: The technical issues have been stated under “Technology Challenge”. The implementation issue that affects our work is resources. There is always a need to identify other groups that do have the resources and to leverage on them to accomplish our goals.

Performance Measures: Our immediate performance measures would be

- The successful identification of the work that is being done for rapid detection of microbial contamination of water
- A successful pilot test, with focus on current limitations (e.g., sensitivity and specificity; live/dead), for the technology that is getting closer to be off-the-shelf.
- Identification of technologies that have been successfully applied to clinical, food and other industries that can potentially be adapted to the water industry

Lessons Learned:

Make the team's goal 'environmental issue' focused rather than 'technology' focused, because there may not be the perfect technology that meets the need of the environmental problem.

The forum with its web site, sends the message out that EPA is serious about utilizing cutting edge technology for solving water issues. This group is using the forum to find research gaps, and training and informing the appropriate people about the technologies available by workshops, presentations and literature reviews. Thus, it has proven to be a valuable tool to propagate the use of these methods in the water arena, an arena where molecular methods have yet to make a mark or be on a par with the food and clinical

industries. Funding is badly needed, especially to develop and implement a pilot test plan.