Improving India's Water Technology

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New filter provides low-pressure solution

India is regarded as one of the fastest growing global markets. With an official Indian government growth forecast of 8.75% in 2011, the country emerged relatively unscathed from the recent global economic downturn.

India occupies only 2.4% of the world's landmass (Figure 1), but it has more than 15% of the world's population, with a median age of 25. Approximately 70% of India's population lives in more than 550,000 villages; the rest of the population lives in more than 200 towns and cities.

Developers of drinking water filtration technologies for use in India are faced with some unique market dynamics:

- Large segments of the population live in areas without access to pressurized water supplies;
- Areas with pressurized water supplies are not necessarily subject to constant water pressure or well-constructed infrastructure; and
- Some areas face significant sediment issues.

Figure 1. Map of India

With such unique challenges, a technology that can operate in both pressurized and gravity-fed applications, and that is able to work efficiently in areas of high sediment, would be an ideal solution for use in drinking water filtration systems.

There is a growing need for point-of-use (POU) water treatment products to remove pathogenic microorganisms from drinking water supplies in countries such as India. Current technologies require significant water pressures that typically are not available to drive the technology. A new microbiological water purification technology has been developed that operates at low water pressures and also under gravity conditions. This technology achieves microbiological reduction to the U.S. Environmental Protection Agency (EPA) Guide Protocol of 99.9999% for bacteria, 99.99% for viruses and 99.95% for cysts.

This technology can offer several performance features, such as reduction of sediment, chlorine taste and odor, lead and volatile organic carbon (VOC). This microbiological purification technology complements all the features and benefits of base filtration media, giving consumers a robust microbiological solution adaptable to several applications and environments.

Testing India's Systems

Five different filtration systems currently on the market in India were purchased and tested for their ability to reduce bacteria and viruses according to the U.S. EPA Guide Protocol. Several of the units claim bacteria and virus reduction in their product manuals or

Figure 2. *E. coli* Caught in Nano-Diameter-Sized Fibers

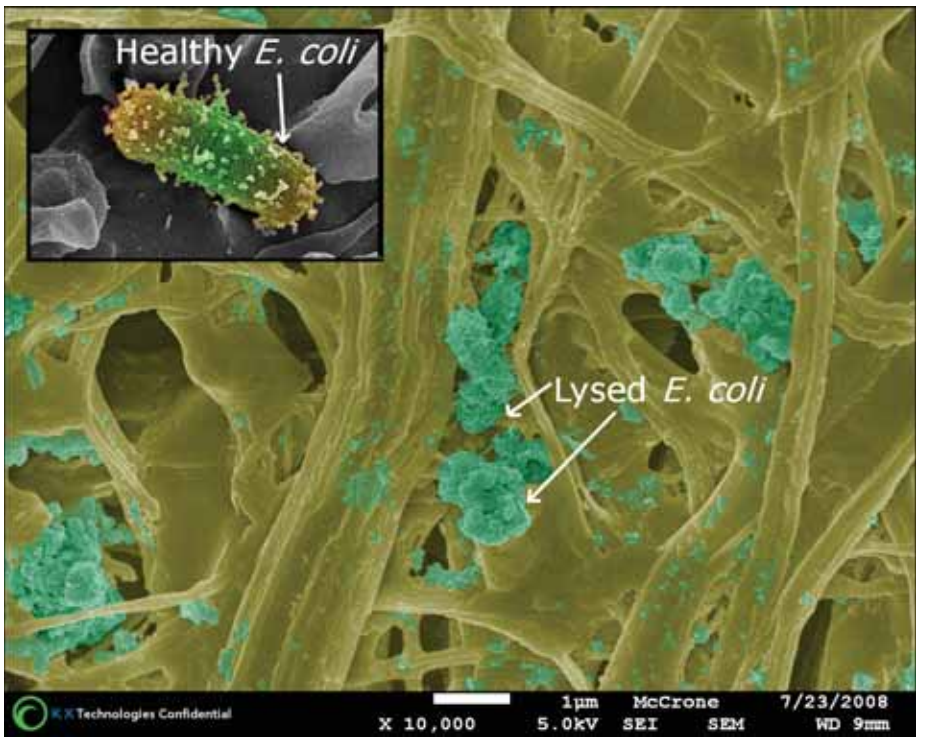
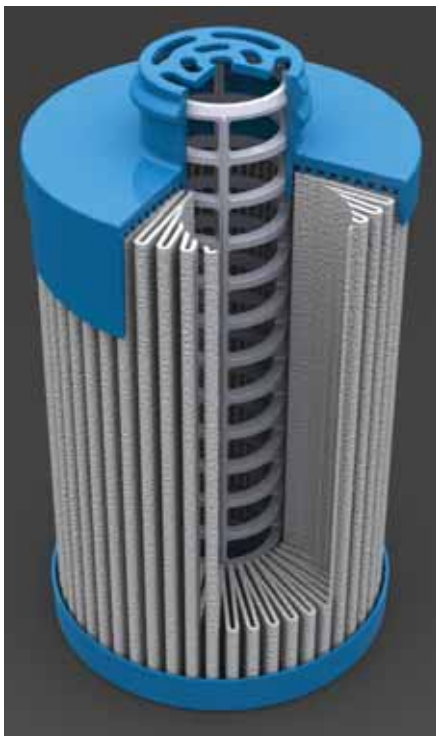


Figure 3. FACT Media Filter



on the product's packaging. The product's filtration technologies varied, including carbon, stone, mineral, carbon nanopapers and ceramic filters.

The test method was as follows:

- All units were tested using dechlorinated city water.
- Approximately 10 liters per day of challenge were passed through each unit.
- Flow rate: gravity flow.
- Bacteria influent: *E. coli* – ATCC11229 10^5 to 10^6 CFU/100 mL of water.
- Effluent bacteria specification: 6-log reduction minimum.
- Virus influent: MS2, 10^5 to 10^6 PFU/mL of water.
- Effluent virus specification: 4-log reduction minimum.
- Testing was terminated at fail points.

The results were inconsistent with the NSF Intl. P231 Protocol. Of the five units tested, only one unit provided bacteria reduction to 99.9999% and virus reduction to 99.99%; this was accomplished through the introduction of chlorine to the unit's filtration system.

Standards Development

The government of India is developing a Bureau of India Standards (BIS) and protocols for microbiological purifiers. Concurrently, the Water Quality Assn. India Task Force is also developing standards and protocols for microbiological purifiers. Both of these efforts are using the U.S. EPA Guide Protocol for Microbiological Water Purifiers (1987) as the base from which to develop the Indian standard. The debate in India appears to be focusing on the reduction levels.

As noted by Joe Brown and Mark D. Sobey of the World Health Organization in "Evaluating household water treatment options: health-based targets and performance specifications," the standard may be heading toward ≥ 2 log bacteria, ≥ 3 log virus and ≥ 2 log cyst reduction, as compared to ≥ 6 log bacteria, ≥ 4 log virus and ≥ 3 log cyst reduction as noted in the EPA Guide Protocol. The ≥ 2 log bacteria, ≥ 3 log virus and ≥ 2 log cyst reduction performance is characterized as "Protective. Achieves intermediate risk-based target of 10^{-4} DALYs per person/year, representing improved water quality."[1]

A New Option

KX Technologies has developed FACT Media along with rapid prototyping of formulations, featuring fiber-based products enhanced through fibrillation, combined with other materials such as carbon or lead-reducing media. These products can be pleated, wound into filters or used to wrap extruded carbon block, adding unique capabilities and high performance while enhancing the characteristics of standard block filters. In this way, new technology can be retrofitted to perform throughout the global marketplace in existing filter housings as well as within new product concepts.

This innovative technology greatly expands the filtration surface area and kinetics by allowing the use of fine particles and may allow reduced contact time required for full filtration performance. Virtually any particle or combinations of particles can be immobilized with the FACT Media, opening possibilities for new and better materials that can enhance the level of filtration within the filter. The smaller fibers also allow a greater pore area for lower pressure drop while maintaining a small pore size.

FACT Media is made using various adsorbents immobilized by fibrillated cellulosic nanofibers. Produced in a wet-laid process, the FACT technology yields a uniform product in which high percentages of small adsorbents (≤ 1µm) can be immobilized. This technology can operate at extremely low pressures or under gravity. Nano-diameter-sized fibers produce a large relative pore area for a given pore size, resulting in a structure that gives a lower overall pressure drop and high dirt-loading capacity (Figure 2). Unlike typical cellulose fibers, which have fiber diameters between 15 and 30 microns, FACT fibers can be as small as 50 nanometers in diameter.

Application

A FACT Media Filter designed to be used under gravity applications has been tested for microbiological reduction. Figure 3 shows an image of this filter. The FACT Media is pleated and wound around a central core.

The FACT Media technology, which is not chemical-based, provides 6-log bacteria reduction and 4-log virus reduction, an effective microbiological reduction filter for gravity applications. This results in a microbiological purification technology that includes all the features and benefits of base filtration media, such as microbial purification, chemical reduction and high flow rate at low (gravity) pressure. Consumers can be offered a truly robust microbiological solution that is easily adaptable to several applications and environments, offering them a wide variety of choices and solutions for drinking water filtration.

Quick Facts on India

People

Population (2010 est.): 1.17 billion; urban 29%
Annual population growth rate: 1.376%
Languages: Hindi, English and 16 other official languages
Education: Years compulsory—K-10
Literacy: 61%
Work force (est.): 467 million
Agriculture—52%
Industry and commerce—14%
Services and government—34%

Economy

Gross domestic product (GDP) (FY 2009 est.): $1.095 trillion
Real growth rate (2009 est.): 6.5%
Per capita GDP (PPP, FY 2008): $3,100

Source: U.S. State Department World Fact Book

References

1. Table 1. Recommended performance specifications for household water treatment options in uncharacterized water, "Evaluating household water treatment options: health-based targets and performance specifications," Joe Brown and Mark D. Sobey, World Health Organization, Draft Nov. 10, 2010. wqp

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