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Water Recycling and Reuse: Technologies and Materials .
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INTRODUCTION

As we become ever more acutely aware of the growing water crisis, we begin to look to ways to assuage it. Water recycling and reuse is one of those ways. BCC conducted this study specifically to look at this important industry and how it is growing and responding to water conservation efforts around the world.

This important report offers a roadmap for new developments in the way we deal with one of our most precious natural resources. Only by analyzing the water recycling and reuse industry as it is today and by considering the factors that drive demand for recycling and reuse technologies tomorrow may we chart an informed path into the future.

Specifically, the report describes the companies that manufacture water recycling and reuse technologies; the most prevalent technologies available for recycling and reuse; the utilization rate of each technology; the factors that influence recycling and reuse activities; and lastly, markets and applications for which recycling and reuse technologies are produced.

This study will be valuable to agencies on the front lines of the effort to develop sustainable water plans for the future. But this report will also be invaluable to those firms involved in manufacturing water recycling and reuse technologies. They face a potentially enormous increase in demand for their products and services in the coming years. Not only will the study offer them information about what their competitors are doing, it also will offer a detailed analysis of the key factors that drive reuse - the same factors that will determine the future of the market.

SCOPE OF STUDY

The report contains:

- The 13 most prevalent recycling and reuse technologies in the U.S. market as well as the markets and applications those technologies serve.
- A detailed look at the factors that will drive the growth of the recycling and reuse market, as well as sources of project funding and regulation requirements.
- Market sizes and five-year forecasts covering the technologies and applications.
- A breakdown of the industry structure as well as profiles for the top companies in the market.
- An in-depth discussion of global markets for water recycling and reuse.
- A patent analysis.

METHODOLOGY

REUSE BY APPLICATION

Reuse numbers were available by application from the 1995 USGS survey of states. That survey allowed us to create a benchmark for reuse broken down by state and by application. We also used as a benchmark a total U.S. reuse number for 2003 derived by the WaterReuse Association. To generate a total reuse estimate for 2004/2005, we gathered data from the largest water reusers (based on 1995 USGS data and information from the WaterReuse Assoc.), including Florida, California, Texas, and Arizona. Using current reuse numbers from these states and the percentage share of all reuse that these states represented in 1995, we extrapolated an estimate for total U.S. reuse in 2005. To generate an estimate of reuse by application we looked at each state's reuse by application and used 1995 USGS benchmarks. To generate an average annual growth rate we used the compounded annual growth in water reuse from 1995 to 2005 and WaterReuse Association's 2003 growth rate as benchmarks.

REVENUE BY TECHNOLOGY, REVENUE BY APPLICATION, AND REVENUE BY TECHNOLOGY AND APPLICATION

We used 2005 as our base year; all calculations were derived from that year. For the total wastewater reclamation and reuse industry revenue in 2005 we used ITT's estimate (the company's estimates were $1.2-1.5 billion in 2000 and $2.8-3.0 billion in 2010, yielding a growth rate of approximately 8.8% from which we extrapolated 2005 revenue).

This revenue growth rate is smaller than the reuse by application growth rate (11.1%) because the cost of these technologies is decreasing over time. Given an increase in the amount of water reused and a corresponding increase in installed capabilities (wastewater treatment projects, in general) and a innovation market in which the cost of technologies is decreasing, the rate of growth of revenue (price paid for technologies) will be slower than the rate of growth of the number of installed technologies.

Knowing total industry revenue in 2003, 2004, 2005, and 2010 as well as the corresponding AAGR, we had to figure out revenue and growth for the same years for each technology individually. To do this we used information gathered from a comprehensive review of U.S. wastewater reclamation plants as well as industrial and other facilities that recycle their wastewater on site. We researched over 100 of the country's (U.S.) largest and most well-known water reclamation plants to see what treatment methods they used and for what applications. From that review we gathered information on installed technologies and the application of the reclaimed water.

To accurately use that installation information we had to break down the industry into categories: disinfection, filtration, and demineralization, as each treatment category has different purposes and may thus be used at the same treatment facility. It wouldn't have worked to simply say that 30% of installed technologies are conventional filtration so revenue from conventional filtration = 30% of total revenue (again, this is because many facilities use conventional filtration and chlorination, for instance, so we had to separate those technologies before we could use share-of-installation numbers to generate share-of-revenue numbers).

To generate total filtration and demineralization revenue figures we turned to BCC's *Advanced Wastewater Treatment for Global Markets (E-111)*. From that report we extrapolated a total filtration figure for 2005 of $1,490.0 million and a total demineralization figure for 2005 of $25.0 million.

To generate a 2005 revenue figure for the final of the three categories-disinfection-we simply subtracted the total filtration and demineralization figures ($1,490.0 million and $25.0 million, respectively) from the known total figure ($2,158.0 million) to yield a total disinfection figure for 2005 of approximately $643.0 million.

Next we turned back to the installation information. Based on the technologies installed at the plants surveyed, we calculated a percentage of total filtration installations that was either membrane-based, conventional, wetlands, or MBR. Conventional filtration accounted for approximately 41.2% of all installed filtration technologies; membrane-based filtration accounted for approximately 47.1% of all installed technologies; wetlands accounted for approximately 2.4%; and membrane bioreactors (MBRs) accounted for 9.4%.

We performed the same type of analysis for disinfection and demineralization technologies. Based on the number of treatment plants using chlorination, ozonation, or UV irradiation as disinfection methods, approximately 73.2% used chlorination (about a third of those also used dechlorination); approximately 24.4% used UV irradiation; and approximately 2.4% used ozonation.

Based on the number of treatment plants using demineralization technologies, approximately 82.4% used ion exchange; approximately 11.8% used electrodialysis reversal (EDR); and approximately 5.9% used deionization. No plants surveyed used electrodialysis or electrodeionization.

Membrane-based technologies required further breaking down, into microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), and reverse osmosis (RO). Of the plants that used membrane-based filtration technologies, 22.4% used MF; 32.7% used UF; 4.1% used NF; and 40.8% used RO.

We then took each technology's respective share of total installations (within each category) and multiplied those percentages by 2005 total revenue to generate a revenue share number for each technology in 2005.

Before we began to consider forecasting 2005 numbers to 2010 and extrapolating them back to 2003 we needed to create revenue numbers by application (we had the numbers in aggregate and by technology, now we needed the number by application and by technology and application).

We began by using the installation information to find out how many treatment plants reclaimed water for each application (in other words, we generated a share-of-total-installations number for each application).

Next, we forecasted the number of installations of each technology for each application to 2010. The AAGR% 2005-2010 in the aggregate table, which shows the number of

installations using all technologies for each application would equal the AAGR for reuse by application. We made this assumption because the amount of wastewater reused (reuse by application table) dictates the number of water reclamation installations. For example, if a typical MF system treats 5 million gallons/day (mgd), then if reuse were to increase to 10 mgd (a 200% increase), then another MF system would need to be installed (also a 200% increase). While in reality this correlation is probably not exactly 1:1, it is close enough to validate the assumption for our purposes.

But while in aggregate the growth rate of installations serving each application will equal the growth rate from the reuse by application table, the growth rate of specific technologies catering to an application could certainly vary. To create growth rates for each application and each technology, then, we again broke the technologies into three categories: filtration, disinfection, and demineralization. Within each group, for each application, we considered the factors that would cause one technology to grow more quickly than another. The most important factors include replacement (whether one technology is replacing or being replaced by another) and cost (how the cost is changing over time). It should be noted that at this point we are still dealing with number of installations, not revenue.

In cases where a technology was not replacing or being replaced by another technology, the growth rate of that technology for each application mirrored the aggregate growth rate of the application over all technologies.

Once we had determined growth rates for each technology and each application, we were able to calculate the number of installations for each in 2003, 2004, and 2010 (we assumed an annual growth rate for 2003 and 2004 equal to the AAGR 2005-2010). We then calculated the percentage share of total installations for each application within each specific technology (e.g. there were 10.68 MF installations, of which 17% served landscape irrigation applications and 11% served agricultural irrigation applications, etc.).

Next we had to get from installation numbers and forecasts to revenue numbers and forecasts for each application within each technology. While aggregate installation forecasts equal reuse by application forecasts (for reasons described above) installation forecasts do not equal revenue forecasts because the cost of technologies is decreasing over time, so even if the number of installations is increasing, if cost is decreasing, then total revenue will not increase as rapidly as the number of installations.

Given an increase in the amount of water reused and a corresponding increase in installed capabilities (wastewater treatment projects, in general) and a innovation market in which the cost of technologies is decreasing, the rate of growth of revenue (price paid for technologies) will be slower than the rate of growth of the number of installed technologies. The decrease in cost in an established, non-innovative market is 0%, whether the market is growing or not. So for all technologies that are established and not subject to cost-decreasing innovations, installation growth and revenue growth are equal. Technologies in this category include ion exchange, deionization, chlorination, conventional filtration, and wetlands. The decrease in cost in a moderately innovative market is 3% (so revenue is growth is 3% lower than installation growth). Technologies included in this category include MF, UF, and ozonation. The decrease in cost in a highly innovative market is 5% (so revenue growth is 5% lower than installation growth). Technologies included in this category include NF, RO, MBR, EDR, and UV.

Using those cost considerations, we created revenue growth rates from installation growth rates for each technology. That allowed us to calculate total revenue numbers for each technology in 2003, 2004, and 2010 (yielding the revenue by technology table).

To generate revenue numbers for each application within each technology, we used the same process used to calculate 2005 revenue by technology from share of total installation figures: we took the share of total installation figures for each technology and application (shares by application) and multiplied those percentages by the corresponding year's revenue (for said technology) to yield revenue for each application within each specific technology-the revenue by technology and application table.

We then added up the revenues for each application across all technologies, yielding the revenue by application table.

INFORMATION SOURCES

Information for the report was gathered from a variety of sources, including individual company's websites, annual reports, SEC filings, white papers, and product documentation. The U.S. EPA served as a source for much of the treatment regulation information, as it is the governing agency in that area. Municipalities and states were contacted for information about recycling and reuse activities there, as were national and regional USGS contacts. Manufacturers were also queried.

ANALYST'S CREDENTIALS

Molly Castelazo has been conducting research and analysis for over seven years. Molly's award-winning work has been published in newspapers, regional magazines, scholarly journals, and trade publications.

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