

# Amgen finds a way to put wastewater to good use

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WEST GREENWICH -- Imagine using half a million gallons of water every day. That's how much Amgen Inc. goes through daily. The biomanufacturing company uses immense quantities of water to produce mass quantities of the rheumatoid arthritis drug Enbrel.

In comparison, the average New Englander uses up to 150 gallons a day.

"Water is the lifeblood of our process," said Kimball Hall, vice president and general manager of the 75-acre, two-plant facility. The plant's water bill was \$600,000 last year.

It's so important that when the company's supplier, the Kent County Water Authority, sent Amgen a letter in 2004 expressing concern about a strained water supply, the company asked for a written guarantee that it would be able to draw down as much as 800,000 gallons of water a day without fail.

The authority withheld a written guarantee. As the two sides negotiated, Amgen started looking into ways to cut both costs and the company's impact on the environment by reducing water use.

It took a few years and several hundred thousand dollars, but now California-based Amgen has an extensive water conservation system in place at both its drug manufacturing plants here. The company's engineers designed and built a process unique to the facility that has allowed the world's largest biotechnology company to recycle its wastewater and slash its West Greenwich water use by as much as 160,000 gallons a day.

Unable to negotiate with the water authority, Amgen also convinced state lawmakers to pass legislation this summer that guarantees that the Kent County Water Authority will provide Amgen with at least 800,000 gallons of water a day.

While the supply issue was partly responsible for the company's conservation efforts, Amgen also strives to be a good corporate citizen and to be environmentally friendly, said Hall. Plus, the water-conservation system cuts costs for the 1,700-employee plant.

"We wanted to do this, regardless. It's a business, we have to buy the water and we have to pay to dispose of it. Obviously it's a better thing from a financial side for us to do this," said James Dean Vogel, associate director of engineering at Amgen.

ENBREL, WHICH is used to treat rheumatoid arthritis, psoriasis, a painful spine disease and other conditions, is based on a human protein. Amgen tricks hamster ovary cells into producing a copy of this specific human protein. The company grows and multiplies the cells in huge stainless-steel vats and then siphons off the protein in a modern-day form of manufacturing.

The basic component for the solution in those vats is water.

"I call it orange juice. You start with a little concentrate and you add water and you get more," said Hall.

In addition to using water to grow the cells, water is also used to filter the drug out of the growing solution. And water is used clean the vats and all the manufacturing equipment after a batch of the drug is made.

However, since the drug is eventually injected directly into humans, Amgen operates under strict regulations set down by the U.S. Food and Drug Administration and the European Union. All the water that goes through the manufacturing process, even the water used to clean up, must be highly purified.

"Everything that goes into the process has to be pure. It's a very nutrient-rich media, so anything we would introduce into the media would proliferate and just grow substantially," said Hall.

Amgen does its own water purification. Consequently, Amgen is required to use more water from the authority than actually goes into its manufacturing process.

About 30 percent of the water that goes through Amgen's purification process is rejected as not being clean enough to be used in the drug-making process. That rejected water used to go down the drain. Amgen, however, has developed a way to reuse that waste.

“Inherently, the pretreatment process uses a lot more than what you end up with,” said Peter Cottrell, manager of facilities and engineering for Amgen in West Greenwich.

The water that comes into the plant from the authority is for drinking, so it's filled with chlorine and other minerals that keep it clean and allow it to be easily absorbed into the human body through the digestive system, said Cottrell. That water, however, isn't clean enough to be injected into human veins.

Inside Amgen's massive \$1.1-billion manufacturing plant sits its water-purification system, a maze of pipes and tubes, valves and containers that is constantly pulsing with water from the authority.

Amgen starts by filtering out tiny amounts of fine silts and salts from the water using sand. Then, the water is softened to remove calcium and magnesium, said Cottrell.

After that, the water is sent through a carbon filter that removes the chlorine. While essential for killing bacteria in drinking water, chlorine could disrupt the drug-making process.

“If the chlorine is left in the water, it will be harmful to our process, but also will be damaging to our equipment because chlorine is a very strong oxidizer, it will harm the stainless steel,” said Cottrell.

Pulling out the chlorine makes it easier for bacteria to breed. So, the water is then passed under ultraviolet lights to kill any bacteria.

Then the water, which still contains a small amount of salt, is pumped through a reverse osmosis system. Basically, the water is sent through a membrane. About 70 percent of the water that passes through is purified. That water is sent to the plant to be used to grow cells, siphon Enbrel out of its growing solution, clean the equipment and for other use in the manufacturing process.

The remaining 30 percent which contains the salts - is rejected. While it's considered wastewater for Amgen's purposes, the rejected water is actually so pure that it's no longer safe to drink since all the minerals and the salts the body needs to absorb the water have been taken out, said Cottrell.

“The wastewater is corrosive to humans,” said Cottrell. “It would suck salt out of your body.”

Before Amgen put the water-conservation system in place, at this stage of the process it would just dump

the wastewater. That added up to about 120 gallons a minute being sent down the drain.

Now, that water is pumped across the complex to the company's massive, gray cooling towers. These towers provide cooling water for the plant's chilled water system, which is used for cooling clean rooms and equipment.

Previously, Amgen used to draw down more water from the authority to run through the towers. Now it uses the reject water. For example: during a sticky day in August, Amgen was able to send 140,000 gallons of its rejected water to the cooling towers.

The wastewater is sent through the towers and evaporates into the atmosphere, taking heat with it. About 80 percent of the water that goes to the towers evaporates, the remainder goes into the sewer system.

“It's a good thing to do, it's good for the process, it makes us more efficient,” said Cottrell.

Hall added, “We do see an outcome from a business standpoint -- but it's still part of being a good corporate citizen.”

FOR RHODE ISLAND, Amgen's efforts are an important step toward addressing the state's water-supply issues, according to Harold Ward, an environmental studies professor at Brown University and a member of the Rhode Island Coalition for Water Security.

The Kent County Water Authority has been predicting since last year that growth in the communities it serves is creating water demand that is quickly outpacing water supply. Already, customers and residents are taxing the water-supply system, according to Kent County, which supplies water to businesses and residents in eight communities -- including West Greenwich.

Originally, Amgen had projected that it would need 1.2 million gallons of water a day for both its plants when they reach capacity. Now, with the conservation system in place, the plants are producing one batch of Enbrel every 48 hours and the company is doing long-term planning to possibly manufacture another drug at the plant, said Hall, but the projection for water use is down to 800,000 gallons a day.

“That's a big change, and it's a demonstration that you can use wastewater,” said Ward. “Very little of that is done in the state right now and we need the example of companies that are willing to go the

extra distance and think a little creatively about how to use wastewater."

While Amgen's water needs are greater than most users, the company's effort to cut down on waste is something that the state may eventually require from other companies and residents, said Sen. Michael Lenihan, D-East Greenwich, cochairman of a special legislative committee studying the Kent County Water Authority. The committee, formed last year, is working on finishing a report that will recommend that a statewide commission be formed to analyze water use and come up with a way to reduce consumption and streamline supply.

"It's pretty clear that recycling is really inevitable," said Lenihan. "Most of the problems you see in Kent County are just the tip of the iceberg."

Water quality and availability are key issues for companies in the biopharmaceutical industry, according to Patrick Kelly, vice president of state government relations at the Biotech Industry Organization, an industry group in Washington, D.C.

For Rhode Island, which, like many states, is pushing to grow its biopharmaceutical manufacturing industry, it's important to prove that companies can get the water they need to grow.

"These are major, major issues for companies in this space, and I know there are a lot of states out there touting the fact that they have ample access to water and power," said Kelly.

South Carolina is one of them. The state's economic-development team emphasizes to companies that it can offer an abundance of both low-cost water and power, said Fred Gassaway, executive vice president of Palmetto Economic Development Corporation in Columbia, S.C.

"I think one of the issues that process-related companies have to take into consideration when they locate or expand existing facilities is the availability, cost and water quality of the area they are talking about," said Gassaway. "We've been so very blessed with having proficient aquifers .°. and that's one of the major factors for the biotech industry."

Despite the lure of low-cost utilities in the Southeast, Amgen's presence in Rhode Island shows that the state can attract one of the largest biopharmaceutical manufacturing plants in the world. And the company is continuing to look for ways to cut down on costs and reduce the impact on the environment. Amgen has already cut its annual water costs by an average of 12 percent.

The West Greenwich facility has a team that meets regularly to come up with new ways to save on water and electricity costs, said Cottrell. And some of Amgen's other plants have used West Greenwich as a model to implement recycling processes in their facilities.

"It's the right thing to do," said Vogel.

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