How Bacteria Change Gear

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The greatest challenge we face in keeping your coolant performing at its peak operating characteristics isn't chemical or physical. The challenge is biology - Mother Nature. Every second of every day, every square inch of your coolant sump has millions of bacteria and fungi raining down upon it, like a continuous drizzle of life. Much of this life dies on contact, but there are those that like the environment of the sump. They get excited, they start to eat your coolant and the tramp oils, and then they settle down to raise a family.

The evidence of their settled lifestyle is known as biofilm, a snotty layer of mucus that appear on any surface where there is water and nutrients. Yes, ANY surface. For instance, that gunky layer on your teeth that you brush off almost every morning? Biofilm. The sides of your fish tank? Biofilm. The infection between your lungs and rib cage, or the clogged arteries feeding your heart are also candidates for biofilm. As for industry, the insides of cold-water intake pipes of nuclear reactors, the pipes inside your own company, and most critically, the sides of your machine sump all have biofilms attached to them.

The study of biofilm didn't become a serious field of study until 1985, so this is still the beginning of our understanding. One aspect of how biofilms form is to know how a bacterium goes from swimming about freely using a rapidly rotating whiplike propeller, and then become a happily settled homebody that secretes polysaccharides in concert with all his neighbors.

These researchers asked: What happens to the propeller?

The propeller is connected to a motor via a clutch, enabling it to rotate very quickly. The rotor is about 45 nanometers (.0000018 inches) in diameter, and it turns about 12,000 rpm. This rotor contains the propeller that extends many micrometers outside the cell wall; probably hundreds of times the diameter of the rotor.

The authors found one 'switch' that shuts off the propeller, a glycosyltransferase protein called EpsE. This switch is also used to build biofilms. But how does the switch work?

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They looked for mutant bacteria that could swim freely even when EpsE was present, and found that these mutants had another gene called fliG that made them swim.

Their next task was to find out if EpsE worked as a kind of brake, stopping the rotation entirely, or if it acted as a clutch - disengaging the rotating motor from the propeller. Their experiment showed that EpsE works like a clutch - the motor continues to spin even as our humble bacterium settles down for a quiet life in the suburbs.

The researchers wonder what benefits a clutch has over a brake - suggesting that maybe a clutch is easier to make, or perhaps it gives the bacterium better control over its swimming into the suburb allowing for a better structured biofilm. Perhaps our readers could offer them some suggestions, given our familiarity with machines.

So far this research has only been done on one bacterium, *Bacillus subtilis* - but there's no reason to assume that there aren't a lot of other bacteria that use this same kind of mechanism to move about, including the ones in your sump.

What does the future hold? In our case, we don't want the bacteria to settle down into suburbia - we like the ones that keep moving. It's when they settle down and raise families that our troubles start. So perhaps our coolant compounders could start to add a little dose of EpsE and keep those little guys moving all the time. When it comes to coolant maintenance, a rolling bacterium gathers no stink!