Microbial Life in Water Wells and Its Influences

Groundwater, accessed by wells, is generally regarded as more "pure" than surface water such as founds in streams and ponds, and certainly has fewer microbes of concern to human and livestock health. In Africa, elephants routinely dig holes in sand near streams rather than drinking directly from the stream to access water that is cooler and has less parasite load. Humans certainly followed their lead, and borehole construction was born.

However, for decades now, scientists have understood that various kinds of microorganisms live in aquifers (formations that hold and transmit water to wells and springs), oil and gas reservoirs, and other underground formations. Furthermore, a study of fossils in such formations shows that microorganisms have lived in sediments and rock since very early in Earth history, for at least 2 billion (2,000 million) years, and they have adapted to nearly every environment encountered on Earth, including hot springs near the boiling point of water, ice and snow, and deep in the ocean. In fact, microbes have largely formed the world environment as we now know it.

In aquifer environments, most of the microorganisms that live there naturally are either Bacteria or Archaea, which have cell structures distinctly different from Bacteria. Most of these seem to be native to the formations that became aquifers, some possibly dating from when the sediments became rock formations. Some protozoa are found in relatively shallow aquifers and living algae have been found deep in aquifers in the US state of Montana.

What do the microbes do to affect water quality and well operations?

The main effects are due to microbial activities as they go about "making a living." As with other forms of life, microbes

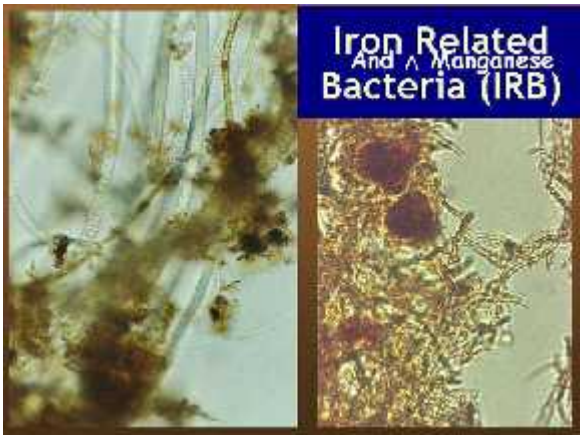
1. Respire and
2. Rid themselves of toxins and waste.

Some microbes can also make organic "food" from carbon dioxide or hydrogen, and some can perform photosynthesis like plants. Among the important *chemolithotrophs* (making organics from inorganic matter) are *methanogens*. These are Archaens that make methane, the source of much of the methane on Earth.

While respiring and detoxifying, many microbes use oxygen as humans do, but many can use other compounds such as nitrate or sulfate, and even certain kinds of iron, in water. These make ammonia (odor and corrosion), sulfides, (odor, corrosion, black color), and d add iron to water. These is only the most common ways bacteria modify their environments.

Other bacteria oxidize iron, manganese, and sulfide for various reasons (including removal of toxins) and these form *biofilms* that can clog filters, pumps, and pipes.

Pump discharge pipe blackened and corroded by sulfide water



It is important to emphasize that these are <u>naturally occurring</u> microorganisms, and not necessarily caused by something like oil and gas development or work by a well contractor.

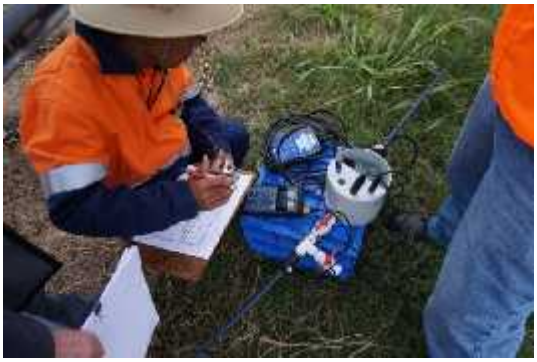
How do you test for these microbes and how do you tell if they come from the natural aquifer or from a disturbance such as oil and gas or other mineral development?

Bacterial iron can usually (but not always) be distinguishable visually from purely mineral iron incrustation by its soft, feathery or slimy appearance, and **microscopically by the presence of bacterial structures and distinct mineral types**. Under the microscope you can see the long, thin filaments or twisting stalks. Iron particles are often incrusted on the bacterial structures. However, the bacteria present consist of many types, and the classy looking filaments and stalks in the textbooks (or pictures at left) may be entirely absent.

It is possible to **culture for some bacteria like sulfate-reducing bacteria or iron-related bacteria** using proven methods.

Most definitive are the new-wave DNA-based methods that can characterize whole microbial ecosystems.

A problem from an outside influence such as oil and gas fluid influence may be distinguished from normal well deterioration by sudden changes in water quality or well behavior, or by forensic studies using geomicrobiological techniques. Most well deterioration is natural (somewhat like our bodies or a motor vehicle), due to clogging and corrosive conditions, build up of bacterial deposits, and time.



Ground Water Science conducts and interprets all these analyses as part of investigations of well and other water problems and in ongoing monitoring. They will be glad to explain methods to you, and help explain what the results mean.

More information? See the following: