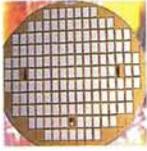


THE FERROFLUIDS STORY



Environmental standards for American industry are getting tougher and tougher. Among recent control measures imposed by the Environmental Protection Agency (EPA) is one that limits the allowable amount of "fugitive emissions" escaping into the atmosphere from petroleum refining and chemical processing facilities, primarily volatile organic compounds, or VOCs.

Compliance with these new regulations is a special headache for oil chemical plants whose process pumps move liquid petroleum and byproducts 24 hours a day. These pumps use mechanical seals to block emissions but the seals inherently allow some vapor emissions. A further problem is the fact that some regional authorities have accelerated implementation of the EPA mandates. So industrial firms are looking for a cost-effective

A NEAR PERFECT SEAL

OF ENORMOUS POTENTIAL

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sealing solution that will not only enable compliance with current rules but will meet the tighter emission requirements on the near horizon.

Ferrofluidics Corporation, Nashua, New Hampshire says it has the answer to the problem: a pump sealing system in which a primary mechanical seal works in tandem with a secondary Ferrofluidic® seal. Ferrofluids are magnetic liquids that do not exist in nature. Man-made substances that originated in space technology, they are fluids in which microscopic metal particles have been suspended, allowing the liquid to be controlled by a magnetic force.

In the various Ferrofluid exclusion seals, permanent magnets create a magnetic field in the air gap between the housing and the rotating shaft of a process pump. Ferrofluid is inserted into the gap and held precisely in place by magnetic force, creating a perfect hermetic seal that stops the

escape of gas and vapor from the mechanical seal.

"We believe our environmental sealing systems, which are specifically configured to combat fugitive emissions, can reduce the leakage to one part in a million," says Alvan F. Chorney, president of Ferrofluidics' Components Group. "The EPA considers 'zero leakage' anything less than 50 parts per million."

The Ferrofluidic sealing system is the product of a three-year cooperative design and development effort on the part of Ferrofluidics; Chevron USA Products Company, one of the largest U.S. refiners and marketers of petroleum products; and BW/IP International, a major supplier of seal and pump products.

Beginning in 1991, the environmental seal underwent extensive field testing at a Chevron refinery against a particular VOC known as light naphtha flush. Testing has since been expanded to include a variety of other emissions at a number of refinery and chemical processing facilities, among them plants operated by DuPont, Shell, Unocal, Amoco and Texaco.



This is a new Ferrofluidics Corporation exclusion seal that promises enormous improvement in controlling "fugitive emissions" that escape from industrial equipment; the seal is a spinoff product of a fast-growing company that is itself a spinoff founded on space technology.

Since its commercial introduction in January 1993, the sealing system has won endorsement from many leading industrial companies. Ferrofluidics and BW/IP are optimistic about business prospects in the refinery, chemical, pharmaceutical and paper industries.

The Ferrofluidics story is one of the real classics in the annals of aerospace technology transfer, a tale of how an apparently unproductive NASA research program generated a spinoff technology that an imaginative entrepreneur built into a thriving, multimillion dollar business.

It started in the early days of the space program when Lewis Research Center was looking for a way to feed weightless liquid fuel into the engine of an orbiting spacecraft. A Lewis scientist hit upon the idea of magnetizing the fuel by dispersing within it finely ground particles of iron oxide; the fuel could then be drawn into the engine by magnetic force. But about that time the rapid advance of solid rocket technology put the magnetic fluid concept on the shelf.

The concept surfaced again a few years later at Avco Space Systems Division as a possible means of controlling the temperature of an orbiting spacecraft. Again it was shelved in favor of another solution. But two Avco scientists — Dr. Ronald Moskowitz and Dr. Ronald Rosensweig — saw great potential in ferrofluids. After advancing the earlier research to a commercially viable level, they formed Ferrofluidics Corporation in 1968. Moskowitz has remained with the company since its inception; he is now chairman of the board and chief executive officer.

The early years were lean ones as the small company focused on R&D and sought commercial applications. It found an initial use in a zero leakage non-wearing seal for the rotating shaft of a system for making semiconductor chips. The seal solved a persistent problem — contamination due to leaking seals — and sparked widespread interest in the technology.

Since then Ferrofluidics' product line has expanded in big leaps. The principal revenue generators are its rotary feedthrough seals for the semiconductor industry. The company additionally produces sealing systems for other contamination-sensitive applications, such as computer disc drives, halogen lamps and medical x-ray equipment. Other products include hydrodynamic bearings, a high-performance alternative to mechanical bearings; inertial dampers for such applications as plotters, printers, optical scanners, machine tools and medical equipment; fully automated crystal growing systems; and fluids for home and automotive loudspeakers.

The spinoff company built on an obscure space concept is now the world's leader in ferrofluid technology. It has grown from a tiny firm that had \$65,000 in sales in its first year into a \$30 million a year company with subsidiaries in Europe, Japan and Taiwan; an investment in biotechnology; and a collaborative venture with International Jensen in ferrofluid-based noise cancellation technology.

But the best is yet to come, Ferrofluidics officials feel. Their unique technology is regularly finding new applications and the company is ranked among the "IB 100" — International Business magazine's list of the 100 fastest-growing U.S. firms. A consensus of analysts suggests that sales will top the \$100 million level before the end of the decade; some think that the environmental seal alone can generate \$100 million a year in sales within five years. •

* Ferrofluidic is a registered trademark of Ferrofluidics Corporation.

Ferrofluidics' Alvan Chorney demonstrates use of the environmental seal in a model of a refinery pump.

