New suspension may smooth maglev ride

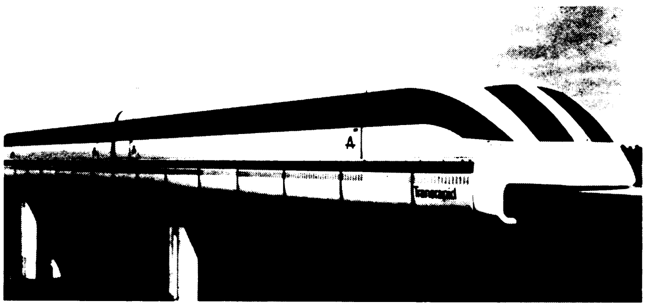
Using a new class of liquids that stiffen into semisolids when subjected to an electric field, engineers may have an easier time designing magnetically levitated trains that provide comfortable as well as fast service.

These materials, called electrorheological fluids, would fill shock absorbers and dampen the bouncing or swaying of these very high-speed trains, says Dilip K. Bhadra, a physicist with the research company General Atomics in San Diego. He described the new materials last week in Washington, D.C., at the annual meeting of the Transportation Research Board.

Such a suspension system could be a key to magnetic levitation's success. Several analyses presented at the meeting indicate that passenger discomfort could limit how fast maglev trains could travel and, consequently, could curtail their competitiveness.

These trains make use of powerful magnetic fields – possibly via high-temperature superconductors – to lift and power them along guideways at speeds near 300 miles per hour. Germany and Japan have had mixed success building prototype maglev trains, and some experts question whether this technology will ever be practical.

Although progress has been slower in the United States, the Intermodal Surface Transportation Efficiency Act, signed into law in December, now calls upon federal agencies to help develop a prototype maglev system by 1999. Bhadra's research is part of the technology assessment program for meeting this goal.



Smithsonian News Service/Washington, D.C.

A German consortium, Transrapid International, developed this prototype maglev train, which reaches speeds of more than 300 miles per hour.

Discovered almost 40 years ago, electrorheological materials have only recently received serious attention as shock absorbers because early versions corroded their containers, says Bhadra. As a suspension system for maglev vehicles, "it's potentially less complex, with less things to go wrong, and could be more cost effective [than other approaches]," he told Science News.

Being electronically activated, this system also should work faster than active hydraulic or linear motor-controlled suspensions. It has no moving parts, and the current needed "is just a signal that tells the fluids what to do," says Bhadra. "We never need any real power to drive the fluid."

When voltage is applied to plates in the oil-based fluid, lithium polymethacrylate molecules suspended in silicon oil take just a few milliseconds to line up in an array that makes the fluid stiff. In this state, the material can dampen motion the way shock absorbers smooth a car ride. The stronger the electric field created, the stronger the damping power. When the current is turned off, the material becomes liquid again.

While several car manufacturers are looking into using electrorheological fluids in automobile shock absorbers, clutches and engine mounts, this technology has not yet proved its value outside the laboratory, Bhadra says.

Whatever the technology used, a very good secondary suspension system is important if magnetic levitation is to ever fulfill its potential. Steven G. Carlton, an electrical engineer with Martin Marietta Corp. in Washington, D.C., figured out trip times for a maglev train running between New York City and Syracuse, N.Y. For his analysis, he routed the train along existing rail or interstate right-of-ways. If the train took these right-of-way curves as fast as it could, or else banked steeply as it rounded the curves, then the trip would take only slightly more than an hour, Carlton calculated. But to spare passengers the sensation of rolling around on an adventure ride, he says, the train would have to slow down, increasing trip time by about 50 percent – unless maglev builders want to pay extra to expand or change existing routes to soften the curves.

A suspension system could lessen the impact of these forces on passengers, says Richard D. Thornton, an electrical engineer at the Massachusetts Institute of Technology. Even so, he notes, maglev passengers will wear seat belts because the ride will be more like a plane's than a train's. *– E. Pennisi*

Meteorite hopscotched across Argentina

A chain of craters running across part of Argentina formed during an extremely rare type of meteorite impact a few thousand years ago, according to two researchers. Instead of crashing solidly into the ground, the meteorite hit at a shallow angle, apparently breaking into pieces that ricocheted and gauged their way across the landscape.

"We've seen these [types of craters] on other planets and produced them in the laboratory, but we've never found them on Earth before," says Peter H. Schultz, a planetary scientist at Brown University in Providence, R.I., who studied the craters along with Ruben E. Lianza of LTV Aircraft Products Group in Dallas. Lianza discovered the features while flying over the Pampas region of Argentina. The two described their work in the Jan. 16 Nature.

The researchers located 10 oblong craters strung in a 50-kilometer-long line near Rio Cuarto. The largest of the shallow depressions measures roughly 4 km long by 1 km wide. Inside the holes, Schultz and Lianza found pieces of meteorite rock, the largest about fist size. They also discovered glassy fragments, formed when heat from the impact melted the surrounding rock.

Schultz estimates the meteorite was 150 meters in diameter, and moving at about 25 kilometers per second (more than 55,000 miles per hour). To account for the line of stretched-out craters, Schultz says the meteorite must have hit at an extremely shallow angle, between 5 degrees and 15 degrees above horizontal. It either broke up before hitting the ground or after the first strike, sending a narrow spray of pieces flying ahead.

Schultz

Arrow marks a person standing in one of the smaller oblong craters

Because the craters do not yet show significant signs of erosion, Schultz believes the impact occurred as little as 2,000 years ago, a time when humans inhabited this region and may have witnessed the event. *– R. Monastersky*