Enhancing Thermal
Conductivity and Reducing Friction

Argonne National Laboratory currently has several projects underway to develop advanced fluids, films, coatings, and processes to improve thermal conductivity and reduce friction. These measures are helping to increase energy efficiency for next-generation transportation applications.

What is Argonne doing?

Superhard and Slick Coating (SSC)

Opportunity: Friction, wear, and lubrication strongly affect the energy efficiency, durability, and environmental compatibility of all kinds of moving mechanical systems, including engines. Frictional losses in an engine can account for 10 to 20 percent of the total fuel energy, depending on factors such as engine size, type, driving conditions, and weather. The amount of emissions produced by engines is also strongly related to their fuel economy. In general, the higher the fuel economy, the lower the emissions.

Solution: Argonne researchers developed a superhard and slick coating (SSC) that can increase engine efficiency and component reliability. In laboratory and engine tests, SSC reduced friction by 80 percent compared to uncoated steel and virtually eliminated wear under severe boundary-lubricated sliding regimes.

Outcome: Argonne's SSC was honored with a prestigious R&D 100 Award in 2009. Friction control technologies like this have major energy saving and environmental benefits. With its self-lubricating and low-friction nature, SSC can help to increase the fuel economy and efficiency of future engines.
For more information, contact Ali Erdemir, erdemir@anl.gov

Eliminating Problems with Low-Sulfur Diesel Fuels

Opportunity: The U.S. Environmental Protection Agency (EPA) recently mandated steep reductions in the amount of sulfur allowed in diesel fuels and lubricating oils. While the measure was meant to reduce emissions, the low-sulfur diesel fuels have a lower lubricity, which resulted in several problems such as increased friction and wear in critical engine parts and components.

Solution: Argonne scientists have developed boron-based additives that are environmentally safe and inexpensive. These additives also have an unusual capacity to enhance the anti-friction and anti-wear properties of sliding surfaces in diesel- and gasoline-powered engines.

Outcome: Argonne's nanoscale lubrication technology was patented in 2007. The technology is available for licensing, and discussions are underway with several companies.
For more information, contact Ali Erdemir, erdemir@anl.gov

Using Nanofluids to Control Heat Production

Opportunity: Modern diesel engines for heavy vehicles are designed for the most demanding conditions – driving full loads up steep grades in the hottest temperatures. These conditions call for bigger and heavier radiator systems, which in turn increase the parasitic energy losses from cooling fans.

Solution: To mitigate this problem, Argonne is investigating the use of nanofluids (fluids containing small nanoparticles of metals, oxides, carbides, nitrides, or nanotubes) that enhance the thermal conductivity of the fluid, thereby removing more heat. Research indicates that an ideal nanofluid could result in a reduced radiator size and increased fuel efficiency.

Outcome: Argonne is working with several large companies, including manufacturers of heavy vehicles, tire manufacturers, and manufacturers of nanoparticles, to develop and test nanofluids. This group is also testing various characterization techniques, such as laser scattering and small-angle X-ray scattering to measure nanoparticle size, shape, and distribution.
For more information, contact Jules Routbort, routbort@anl.gov