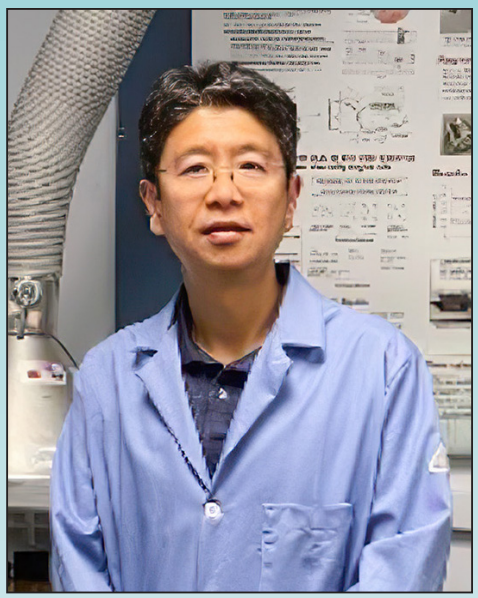
Eco-Friendly, High-Lubricity Ionic Liquids as Lubricant Additives for Hydraulics/Hydropower



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Dr. Qu currently is a distinguished R&D staff scientist and group leader in the Materials Science and Technology Division. His research interests include advanced lubrication, surface engineering, materials tribology, nanostructured materials, and manufacturing. He holds 8 US patents and has published 3 book chapters and 110+ peer-reviewed journal papers with 5,500+ citations. Dr. Qu has received multiple national awards including the 2020 UT-Battelle Distinguished Researcher Award, a 2014 R&D 100 Award, and a 2014 DOE Vehicle Technologies Office R&D Award. He is a Fellow of the Society of Tribologists and Lubrication Engineers and serves on the Board of Directors for Wear of Materials.

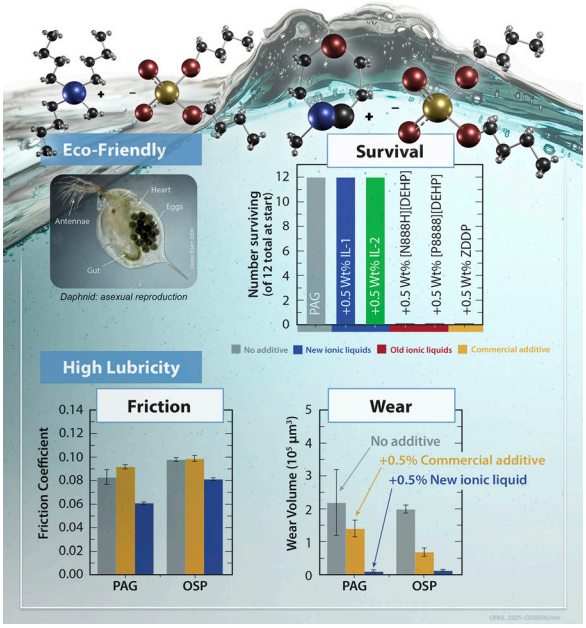
Intellectual Property

"Eco-Friendly Ionic Liquids as Lubricant Additives," Invention Reference 201904491; PCT Application PCT/US2021/043260, July 27, 2021

Problem: Nearly half of all lubricating fluids used in industry—37–61 million liters per year—end up in the environment due to leaks or discharges, with the major sources including hydraulic fluids and hydropower turbomachinery oils. Responses to lubricant leaks and spills cost more than $300 million annually. The need for moving toward eco-friendly lubricants is increasingly recognized. While multiple groups of eco-friendly base fluids have been approved by the US Environmental Protection Agency (EPA), the market lacks anti-wear additives that are both nontoxic and highly lubricative.

Solution: ORNL is a global leader in R&D of ionic liquids (ILs) for lubrication applications, having received a 2014 R&D 100 Award for previous development of ILs for automotive engine oils. The award-winning ORNL team recently developed new groups of eco-friendly high-lubricity ILs as lubricant additives for hydraulic and hydropower lubrication. They are thermally stable, nonflammable, noncorrosive, miscible, and chemically compatible with the EPA-approved eco-friendly base oils. In EPA standard chronic aquatic toxicity tests, the model organism, *Daphnia*, had survival rates of 90%–100% when exposed to selected candidate ILs, but they were all killed by the baseline commercial anti-wear additive. In lubricity evaluation, the new ILs outperformed the commercial baseline by reducing friction by an additional 20%–30% and reducing wear by an additional 80%–90%.

Impact: This new class of eco-friendly IL lubricant additives is expected to significantly improve equipment efficiency, durability, and reliability while reducing the environmental impact of lubricant spills or discharges. This eco-friendly IL additives technology is low-cost and production-scalable and can be applied to many industrial sectors including automotive, hydraulics, hydropower, and metalworking. The size of the global eco-friendly lubricants market was $2.7 billion in 2018 and is expected to have a compound annual growth rate of 5.9%—twice that of the overall global lubricants market.



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