Magical transformations in the lab, classroom

Sohail Murad
Professor of chemical engineering

A 17th-century print of an alchemist hangs on the wall of chemical engineering professor Sohail Murad's office.

The print, by Dutch painter Adrian van Ostade, shows the alchemist watching closely as the flames warm a small black pot; a heavy-looking book leans against a crock filled with empty glass bottles, and flasks and distillation vessels of all shapes and sizes clutter the floor.

Murad's tidy office and computer lab don't have much in common with the mysterious workshop, but his passion for studying the detailed interactions of molecules in gases and liquids is akin to the alchemist's.

Rather than try to turn lead into gold, chemical engineers look for ways to turn salty sea-water into fresh; polluted water into pure; or sooty engines into clean-burning ones.

Murad uses computer simulations to study the effect of electrical forces and other influences on molecules in a wide variety of conditions.

For example, he and his students found the answer to a widely-known puzzle: why some ions, like the positively charged sodium atoms in salt water, were not passing through the pores of membranes used to separate salt and fresh water, even though the pores were bigger than the ions.

Computer simulations, treating each molecule individually, showed the ions tended to form clusters with water or methanol molecules, becoming too large to pass through the membrane.

"Our research won't necessarily have an industrial application as soon as it's done," he said.

"Our goal is to understand, at the molecular level, how a membrane purifies water."

Other engineers will find ways to build a better desalination plant or a cleaner-burning engine based on these results, he said.

Teaching undergraduate and graduate courses in thermodynamics and statistical

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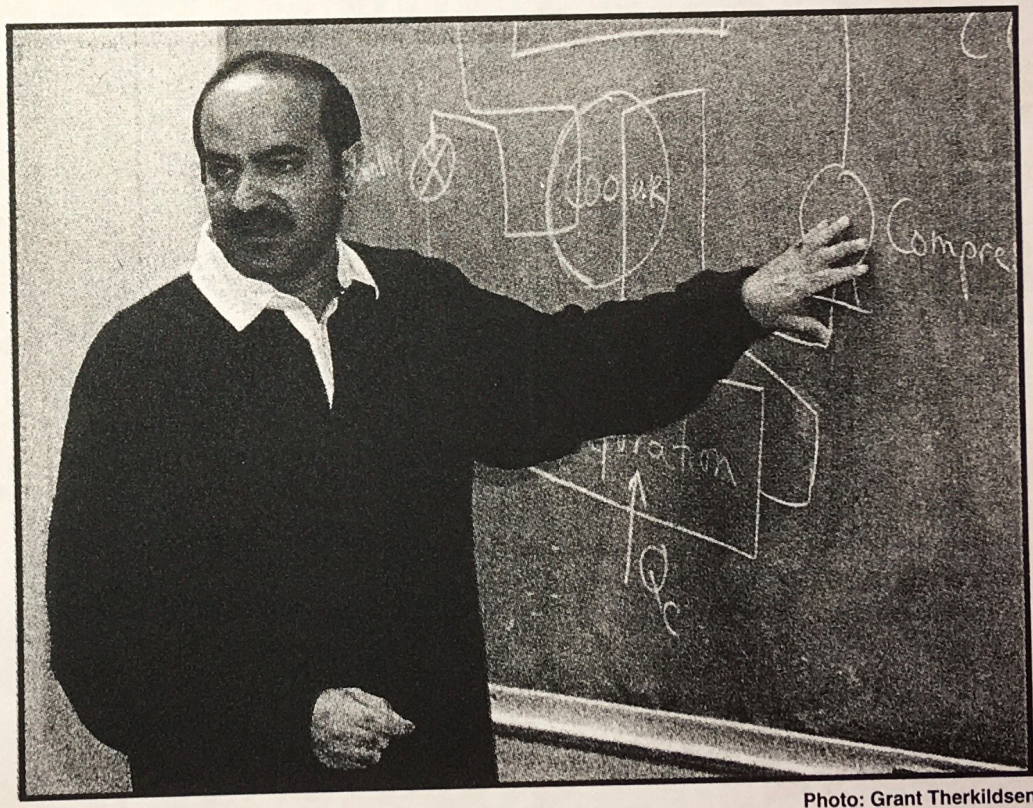

Photo: Grant Therkildsen

Sohail Murad: "My research has greatly benefitted from my teaching."

Murad

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mechanics is an integral part of Murad's work.

"Teaching has not only *not* interfered with my research activities, but my research has greatly benefited from my teaching," he said.

"Especially at the graduate level, students ask tough questions. It can be challenging.

"Sometimes I spend five hours preparing a one-hour lecture. This gives me a much deeper understanding and appreciation of subjects that, previously, I naively thought I understood well."

Murad draws on his expertise in computer simulations to develop course-related software.

— *Leila Belkora*