



Comprehensive cytotoxicity assessment of treated produced water from thermal distillation using human cell lines

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What's the Problem?

Oil and gas production brings large volumes of salty and contaminated water called produced water to the surface. Although thermal distillation removes most of the salts and metals, it may still leave behind small amounts of pollutants — like ammonia, benzene, and other volatile organic compounds — that can harm humans and wildlife. Understanding whether these treated waters are safe for people is critical before any reuse outside the oilfield.

How Was the Study Done?

Real, produced water from two pilot treatment sites in the Permian Basin was collected. The water was treated with two thermal distillation systems (low-temperature distillation and mechanical vapor recompression), then further filtered using granular activated carbon (GAC) and zeolite to remove remaining pollutants. Three types of human cells were tested: breast cells (MCF-7), kidney (HEK293), and intestinal (Caco-2). Scientists exposed these cells to untreated water, distilled water, and post-treated distilled water with GAC and zeolite.

What Were the Results?

- Untreated produced water was toxic, killing cells and triggering stress responses.
- Thermal distillation removed all the compounds affecting cell viability.
- The residual compounds in thermal distillate still caused estrogenic activity and activation of the aryl hydrocarbon receptor.
- The distilled water after GAC and zeolite post-treatment did not elicit adverse cellular responses.

What's Next?

Combining distillation with GAC and zeolite filtration produced non-toxic water; next steps include scaling systems, monitoring undetected organics, confirming safety.

Why Does this Matter?

Safe reuse of treated produced water could reduce disposal volumes and ease freshwater pressures in New Mexico, with results showing advanced treatment technologies may enable safe non-drinking uses.

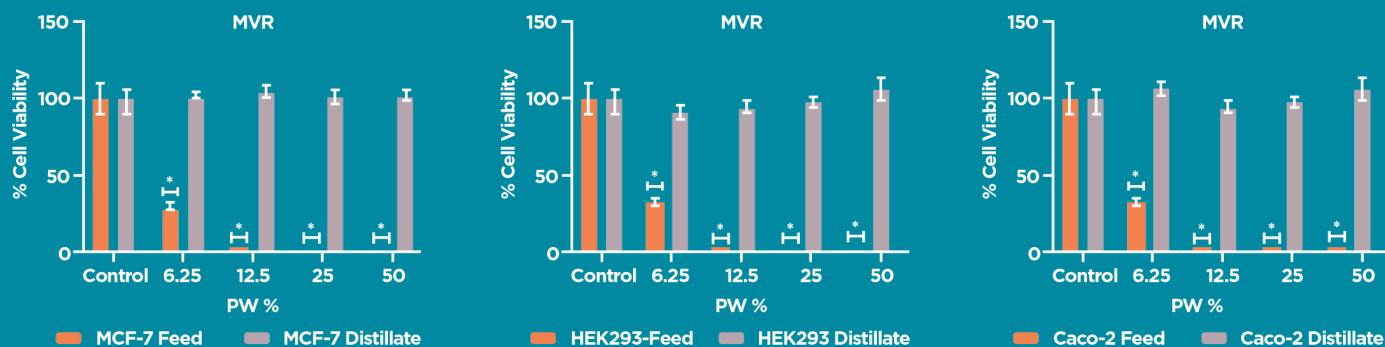


Figure 1: Human breast cancer cells (MCF-7), kidney (HEK293), and embryonic intestinal cell (Caco-2) viability (survival) after exposure to feed and distillate from a thermal desalination pilot unit (MVR, mechanical vapor recompression).