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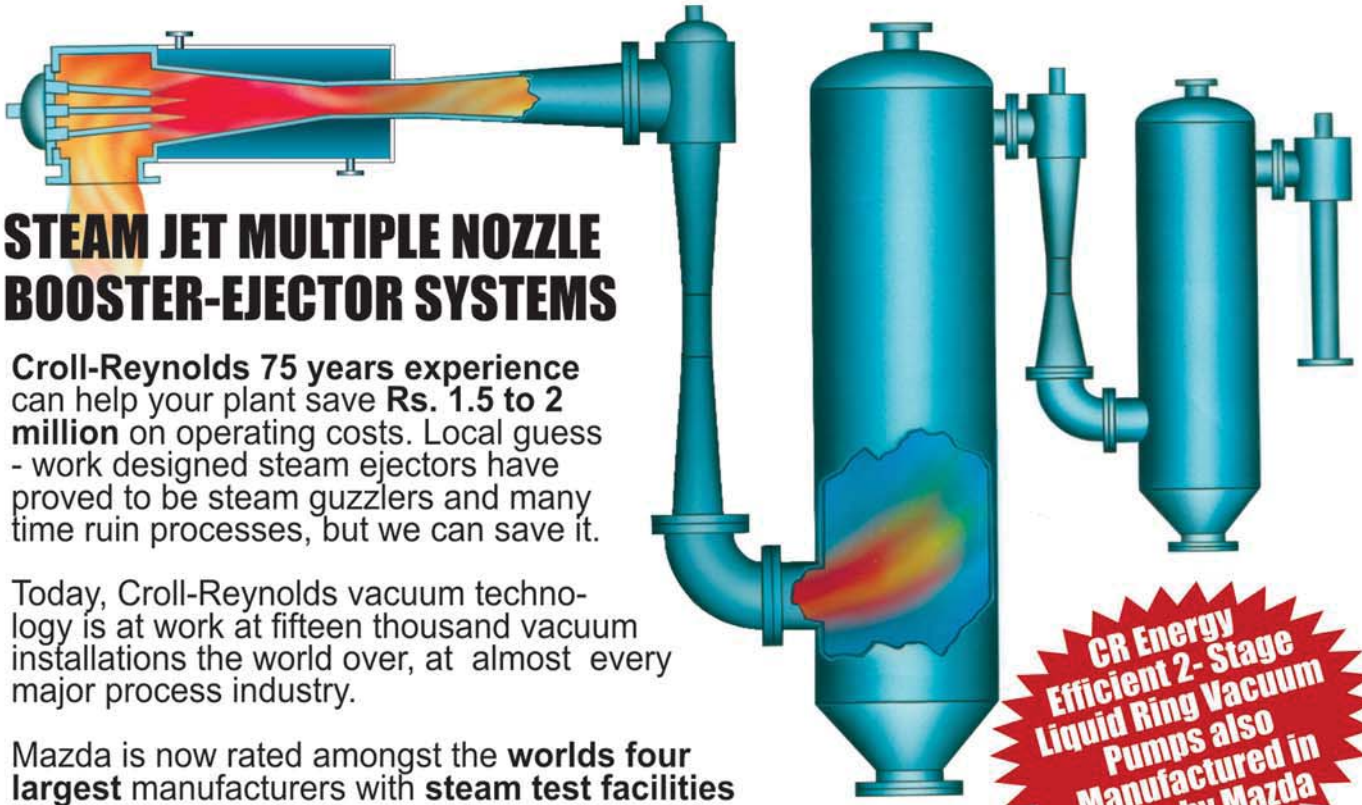

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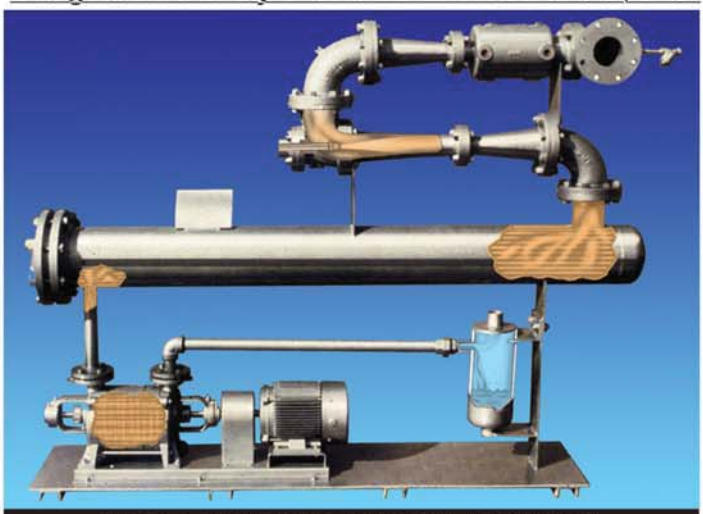

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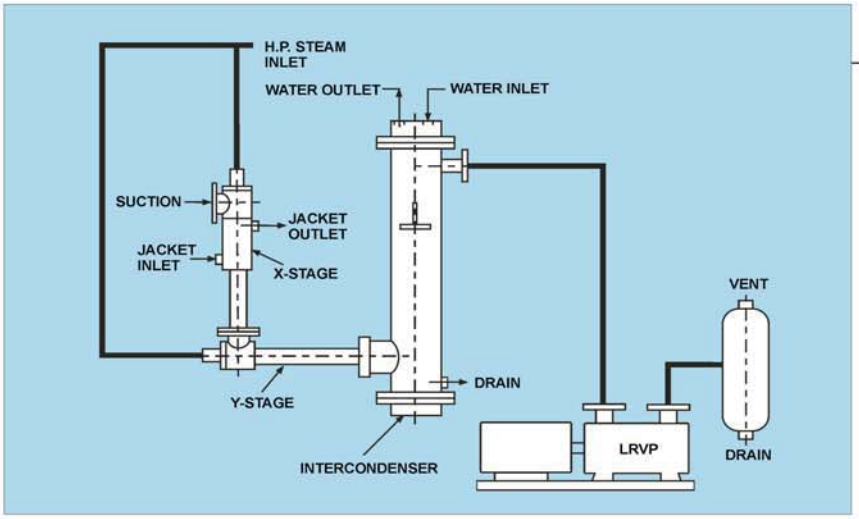

In this hybrid vacuum system, three steam ejectors are combined with a shell-and-tube condenser and liquid-ring vacuum pump. By eliminating the water-jet condenser previously used, Chevron has reduced steam and water consumption and water-treatment needs

The ideal combination: Steam ejectors, a mechanical pump, and a surface condenser

Harry Sung and **Peter Chong***
Chevron Research
and Technology Center

When an earthquake cracked one of the cast-iron stages in a steam-jet vacuum system at Chevron's Research and Technology Center (Richmond, Calif.), the conventional steam ejectors were replaced with a state-of-the-art vacuum system. It combines steam ejectors with a shell-and-tube condenser and a mechanical vacuum pump. Compared with the previous setup, this hybrid uses less steam and water, tolerates warmer condenser water, and has fewer wastewater-treatment requirements.

Chevron's research facility provides drum-scale testing 24 h/d, to profile the hydrocarbon components of crude oil samples from around the world. Vacuum distillation is a critical part of the test procedure.

*Sung is a Senior Design Engineer and Chong is a Process Lab Supervisor at the Chevron Research and Technology Center. They can be reached at 100 Chevron Way, Richmond, CA 94802, Tel.: 510-242-2151.

The original vacuum system, installed in the early 1970s, consisted of three cast-iron, steam-jet ejectors followed by a water jet. The water jet drew a vacuum in the system, and served as both a contact condenser and the fourth vacuum stage. During operation, the four-stage system required 435 lb/h of steam at 100 psig, and 100 gal/min of 70°F water at 30 psig. The old system had a capacity of 5 lb/h of air at a vacuum of 1 Torr.

After an earthquake damaged one of the ejectors, Chevron decided to install a new vacuum system — one that would be more resistant to future damage and consume less steam and water. After evaluating several competing systems, the plant selected one from Croll-Reynolds Co. (Westfield, N.J.).

The rugged steam ejectors, constructed of cast steel-instead of cast iron, use a shell-and-tube condenser instead of a contact jet condenser, and a liquid-ring vacuum pump replaces the final ejector stage (Figure). This system, installed in mid-1990, provides the same capacity and vacuum as the old system, yet it requires only 390 lb/h of 100-psig steam. This reduced steam consumption has allowed Chevron to expand other activities at the facility without adding boiler capacity.

Water consumption is down, too, since the surface condenser only requires 28 gal/min of water at 5 psig. And, unlike the previous water-jet condenser, the cooling water in the shell-and-tube condenser does not contact the process vapors directly, so no treatment is required before discharge.

Liquid drained from the condenser consists of condensate from the three steam ejectors, and hydrocarbons from the vapor stream. It is sent to Chevron's nearby refinery where the hydrocarbon fraction is recovered.

The Croll-Reynolds vacuum system tolerates condenser water as warm as 90°F without adverse impact on system performance or capacity. This ensures stability during the summer months. Since installation of the new system, Chevron has experienced reliable, stable vacuum while conserving water and energy resources.

Croll-Reynolds Co., Westfield, N.J.
Edited by Suzanne Shelley

VACUUM UPGRADE CUTS STEAM & WATER USE

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751 Central Avenue. Westfield, New Jersey 07091-0668
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