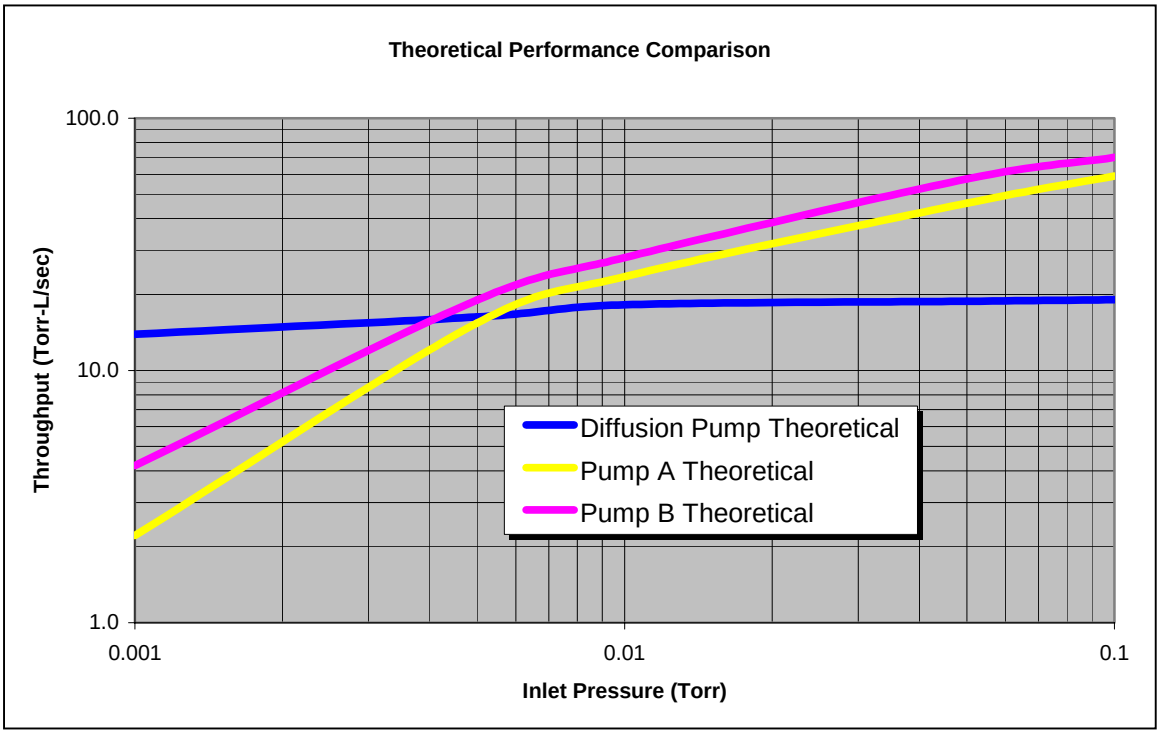
CASE STUDY

Performance Predictions and In-Situ Measurements Augment Traditional Cost-Benefit Analysis

Cost-benefit analyses are very valuable decision-making tools, but oftentimes are based on a multitude of assumptions and little scientific data. An evaluation plan that includes in-situ testing as the final phase is a better alternative.

A large metals processor, with numerous vacuum furnaces, was experiencing both performance and maintenance problems with their diffusion pumps on their primary chamber pump systems. The original processes, along with the corresponding vacuum equipment specifications, were developed many years in the past. Over time, the processes had evolved, but the equipment specifications remained unchanged.

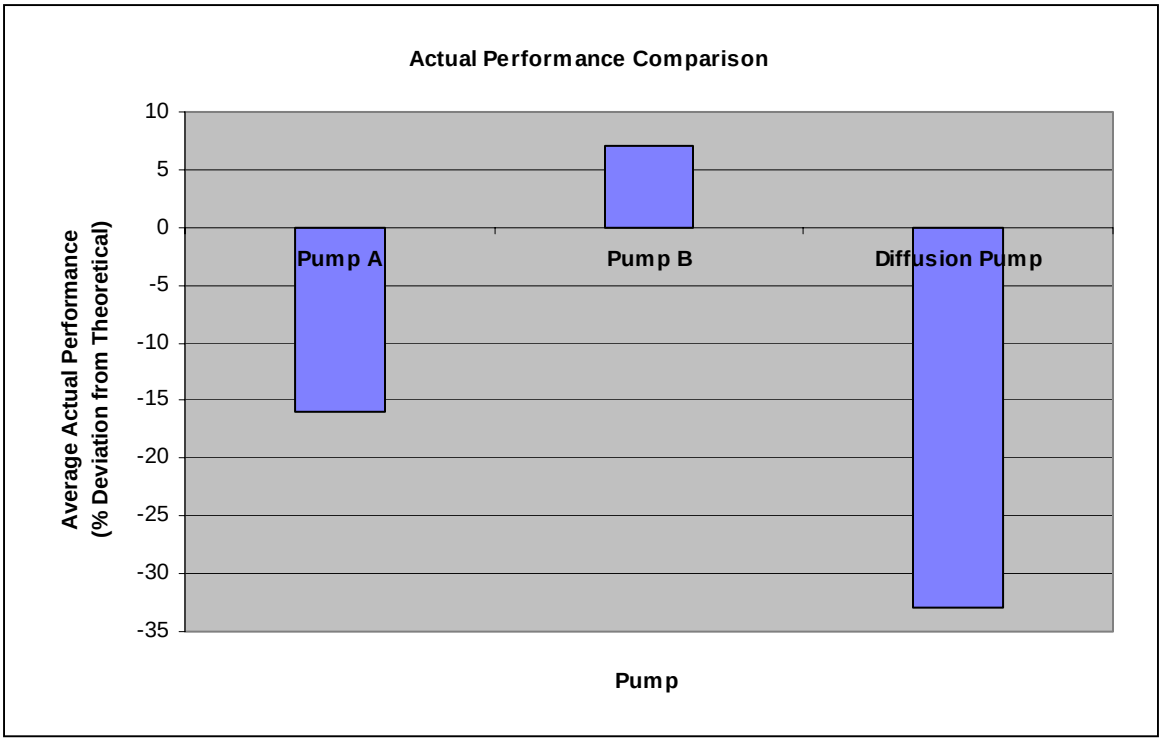
Opus Technologies was asked to evaluate the pump system in relation to the current processes and offer recommendations for modifications to existing equipment and future installations. The primary issue was whether the diffusion pumps were the optimum choice for the current processes, which produced heavy gas loads in the 10^{-2} to 10^{-1} Torr range. To better convey this, theoretical throughput curves of the diffusion pump along with two potential vapor pump replacements were plotted as shown below. The graph clearly shows that improved pumping performance in the critical range could be expected from either of the two potential replacements.



Note: Pump manufacturers, model numbers, pump fluids and heater power consumption were all documented for purposes of original report, but are not discussed here for confidentiality reasons.

Further investigation indicated that the majority of the maintenance issues were also related to regular operation of the diffusion pumps outside of their optimum range. Historical equipment utilization and maintenance downtime figures were used to calculate potential cost savings. This value was then used as the baseline for a cost-benefit analysis of the two potential replacements. The analysis concentrated on seven distinct factors, including purchase price, installation costs, operational costs, etc. Payback periods of 0.83 years and 0.52 years were calculated for the "Pump A" and "Pump B" options respectively.

Lastly, Opus Technologies was able to arrange for in-situ testing of the three pumps in question. Comparisons for each pump were made between theoretical performance and actual performance over the 10^{-3} to 10^{-1} Torr range. The graph below depicts the average deviation from theoretical over that range.



In summary, although both the theoretical performance comparison and the cost-benefit analysis indicated that converting to the "Pump B" option would be beneficial, the inclusion of actual performance data gave the customer the confidence to make the final decision to proceed.

Only a fraction of the data collected and analyzed during the duration of this project are provided in this case study, and are presented to give the reader a brief synopsis of the project's objectives, results and conclusions. Additional information will be supplied upon request, provided doing so does not violate existing non-disclosure agreements or result in a conflict of interest situation.