



Project Summary

Comparison of Relative Emissions from Double Mechanical Pump Seals to Other Types of Pump Shaft Seals

L.P. Provost, J.E. Tobias, and S.L. Preston

This study compares emissions from double mechanical pump seals and other types of pump shaft seals. Analysis of emissions from the EPA Fugitive Emissions Data Base does not show significant differences between double mechanical pump seals and other types of pump shaft seals. Both the percentage of seals leaking and emission factors for double mechanical seals were similar to other types of seals in the data base.

This Project Summary was developed by EPA's Industrial Environmental Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Pump seal data from nine petroleum refineries were extracted from the EPA Fugitive Emissions Data Base for comparison of emissions from double mechanical pump seals to other types of pump shaft seals. Separate comparisons were made for light and heavy liquid service.

Nonmethane leak rates for single and double seals were compared using

schematic plots.¹ Because the emission data have been shown to be lognormally distributed², a logarithmic transformation was performed before the schematic plots were made. The plots illustrated that seal type had practically no effect on leak rate for leaking seals in light or heavy liquid service.

Centrifugal/mechanical pump, centrifugal/packed pump, and reciprocal/packed pump leak rates were also compared with schematic plots. The plots illustrated that pump type had little effect on non-methane leak rate for both light liquid and heavy liquid service.

The percentage of seals leaking and 95 percent confidence intervals about the percentage leaking, were calculated to evaluate the tendency for pump shaft seals to leak. Calculation of confidence intervals is equivalent to performing a Student's t-test on the groups of data. Non-overlapping confidence intervals for two sets of data indicate that a t-test would show the averages of the two data sets to differ significantly.

¹Tukey, John W., *Exploratory Data Analysis*, Volume I, Chapter 5. Reading, Massachusetts: Addison-Wesley Company, 1977

²Weatherold, R. and Provost, L., *Emission Factors and Frequency of Leak Occurrence for Fitting in Refinery Process Units*, EPA-600/2-79-044, February 1979.



Similarly, overlapping confidence intervals indicate no significant difference between the averages of the data sets. The overlapping confidence intervals illustrated that there was no significant difference in percentage of seals leaking between the single and double seals for either light liquid or heavy liquid service. There was also no significant difference in the percentage of seals leaking among centrifugal/mechanical pumps, centrifugal/packed pumps, and reciprocal/packed pumps.

The percentage of seals leaking among centrifugal/mechanical pumps, centrifugal/packed pumps, and reciprocal/packed pumps were compared separately for single and double seal pumps and heavy and light liquid service. In all cases, the confidence intervals for the three types of pumps overlapped, indicating no significant difference among pump types for either single or double seals and light or heavy liquid service.

For a comparison of both the percentage of seals leaking and the amount of leakage per seal, emission factors and 95 percent confidence limits about the emission factors were calculated. No emission factors were calculated for cases where the number of pump seals screened was less than 20 because confidence limits for such small sample sizes would have been extremely wide. For this reason, there was little information for comparison of the effect of pump seals on emission factors for any particular service and seal type. Where enough information for comparisons existed, all emission factor confidence intervals overlapped. This indicated that there was no significant difference in emission

factors between single and double seals for either light or heavy liquid service, no significant difference in emission factors among centrifugal/mechanical, centrifugal/packed, and reciprocal/packed pumps for either light or heavy liquid service, and no significant difference between centrifugal/mechanical and centrifugal/packed pumps for single seal pumps and heavy liquid service.

Conclusions

Analysis of emissions from the refinery data base shows no significant differences between mechanical pump

seals and other types of pump shaft seals.

Recommendations

Lack of significant differences may be due to the small amount of data available when subcategories of pump seals were analyzed. Also, the effect of other variables such as point of emission measurement, whether or not the pump was running, and the particulars of the service for each pump, may mask differences in performance of the various seal types. A more complete study should consider these variables and be based on a larger sample size.

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The complete report, entitled "Comparison of Relative Emissions from Double Mechanical Pump Seals to Other Types of Pump Shaft Seals," (Order No. PB 81-162 083; Cost: \$5.00, subject to change) will be available only from:

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