

THE EFFECT OF VARIABLE FLOW ON HYDRAULIC FILTER

– THE RESEARCH IN TUT/IHA SINCE 1993

Filtration, Variable Flow, Particle Counting

Introduction

The efficiency of hydraulic filters is generally rated using the standardised Multi-pass test, in which the flow rate is constant. In real systems this is rarely the case, which can cause a substantial decrease in the expected filter performance. That is why there is need for new types of test procedures for the testing of hydraulic filters.

Test Results of Filters in PARANA Project

In IHA was carried out PARANA-project 1993-95 in co-operation with 22 participants from Finnish industry. The function of filters was studied with batch tests under variable flow in laboratory test rig. Three flow forms were used; constant, square (0,017Hz) and sine (1 & 2,5 Hz) (figure 1). The results of pressure line filter C are shown in figure 2.

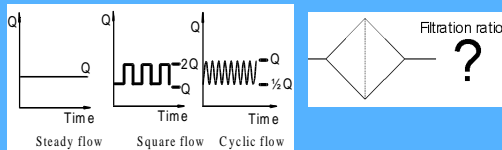


Figure 1. The variable flow forms in PARANA project [1]

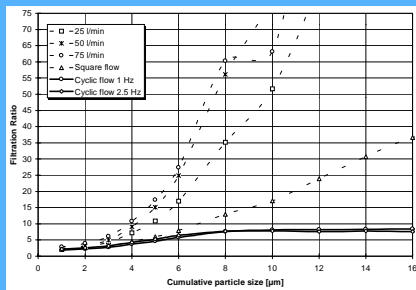


Figure 2. The average filtration ratio of filter C ($\beta_{10} > 75$) [1].

In fig.3 the differences in filtration ratio is clear. The best results are reached with steady flow. Ratio is much lower with square flow and worst with cyclic flow. On the other hand the changes in cyclic flow results between 1...2,5 Hz are minor.

Field Tests of Filtration Ratio

Filtration ratio can vary greatly during the working cycle of system. In figure 3 are shown results from Finnish metal industry, from measurement rounds 2 and 4. The pressures and pressure differences have a strong influence to the number of particles and to the measuring event itself.

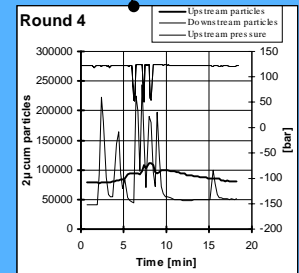
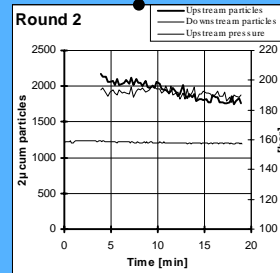
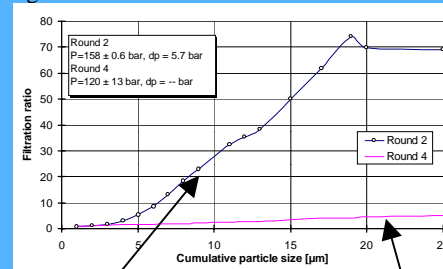


Figure 3. Filtration ratio in field tests. Filter F, $\beta_{10} > 75$.

SUOTU Project

Since 1996 IHA has co-operated with Parker Hannifin/Finn-Filter. In SUOTU projects the aim is to a) increase the knowledge of filter behaviour, b) develop test methods, c) measure efficiency curves for filter selection and d) improve filter performance with variable flow. A simplified illustration of modified Multi-pass unit is presented in fig. 4. The unit as a normal Multi-pass unit but it enables the use of accurate flow variations and the control of particle concentration. The test unit and test procedures used makes it possible to test filters under different conditions, which are near to the actual working conditions.

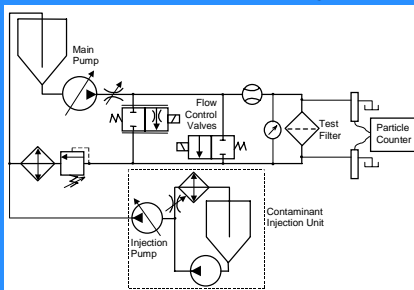


Figure 4. The variable flow Multi-pass filter test unit. [2].

Efficiency Curves for Filter Selection

β -values of 5 μ m and 10 μ m elements tested with constant flow and three different amplitudes are presented in figure 5. The curves show clearly how the flow amplitude affects the efficiency. The spread of curves indicates that a coarse filter is more affected than a finer filter.

This can be seen also in graph where particle sizes x for the definition $\beta_x=100$ are presented for both elements (Fig. 5).

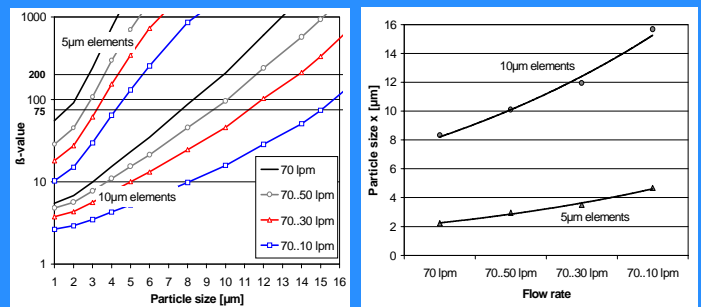


Figure 5. β -values and particle sizes for the definition $\beta_x=100$ of 5 μ m and 10 μ m elements tested with different flow amplitudes. [3]

Conclusion

The laboratory tests show that variable flow affects greatly the efficiency of hydraulic filter. Similar results were got also from field tests in Finnish industry.

A series of 5 μ m and 10 μ m elements were tested using four different flow amplitudes. The presented efficiency curves serve the selection of filter and the evaluation of filtration efficiency with variable flow. The results show also that the definition of filter efficiency cannot be based purely on traditional Multi-pass test.

References

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