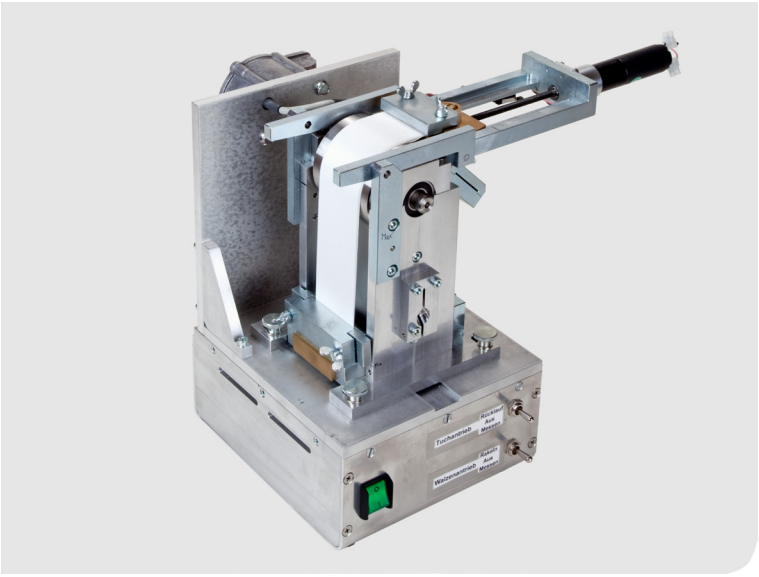

In GIT ReinRaumTechnik 2/2007 the author Win Labuda presents a novel test method to determine the specific cleaning time and efficiency of fine and precision cleaning wipers. This product group also includes the so-called cleanroom wipers. Using devices introduced in 2007 that enable a standardized cleaning procedure, a study has since been carried out which provides an interesting overview of the quality of the most well-known fine and precision cleaning wipers available on the international market.

Classification of Cleanroom Wipers According to Cleaning Efficiency

New Study of Required Cleaning Time and Achievable Surface Cleanliness

Katja Habermüller, Win Labuda,

The study shows that it is also possible to establish meaningful performance characteristics for wipers, which then permit an application-oriented, technical classification. This is a significant contribution to eliminating the uncertainty in this area that exists worldwide. In the following paragraphs, we would like to briefly present the most important findings of the study:

Knit and nonwoven wipers of six well-known manufacturers were analysed in the study regarding the parameters specific cleaning time and specific cleaning efficiency (Berkshire, USA; Clear & Clean, Germany; Contec, USA; Dupont, USA; ITW-Texwipe, USA; Milliken & Co., USA). All test results are shown coded.

Cleaning time

A key parameter of every cleaning procedure is the average required time that is used (cleaning time), depending on the respective cleaning wiper. This is of high economic importance, in particular for industrial users of wipers on a large scale. The diagram in Fig. 1 shows that the

respective specific cleaning time for the tested wipers under the same test conditions varies considerably – between 4.5 and 26.5 seconds. The specific cleaning time in this measurement is defined as the reduction of a standard contamination by 5,000 mass units.

This proves that there are significant differences in the cleaning performance per unit of time among the cleaning wipers available on the market. These ultimately mean differences in quality, which very much determine the time required for a cleaning procedure. Thus, they also affect the cleaning costs for the maintenance of machines and equipment

Specific cleaning efficiency and cleaning time – 10 wipers tested

In some of the cleaning-by-wiping prodcedures, reducing the cleaning time is not the main objective. Rather, the goal is to attain the greatest possible surface cleanliness. This fact was taken into account in the development of test instruments. This now makes it possible to accurately measure the mass of contaminant residues down to the range of a few molecular layers. By knowing these limits, it has been possible to include cleaning-by-wiping in the array of well-known procedures of surface cleaning and to establish it – from a process technology perspective – in its proper place.

For the comparison shown in Table 1, ten fine and precision wipers (only knits) – well-known in Germany and produced by various manufacturers – were selected. Both the specific cleaning time and the specific cleaning efficiency were measured on these samples using the Labuda Timeport device. The specific cleaning time was defined as how long it took to reduce a contaminant mass of 6000 mass units to 1000 mass units. For this test, the contamination, a thin layer of oil, was applied to a rotating metal surface with a roughness of Rz = 4µm. The specific cleaning efficiency was defined as the maximum achievable cleaning efficiency with a particular wiper, in terms of the contaminant residue on the surface after the performed standard cleaning procedure. In practice, precision and fine cleaning wipers are often used as "cleanroom wipers" in a solvent-impregnated state. To take this fact into account in the test, all measurements were first

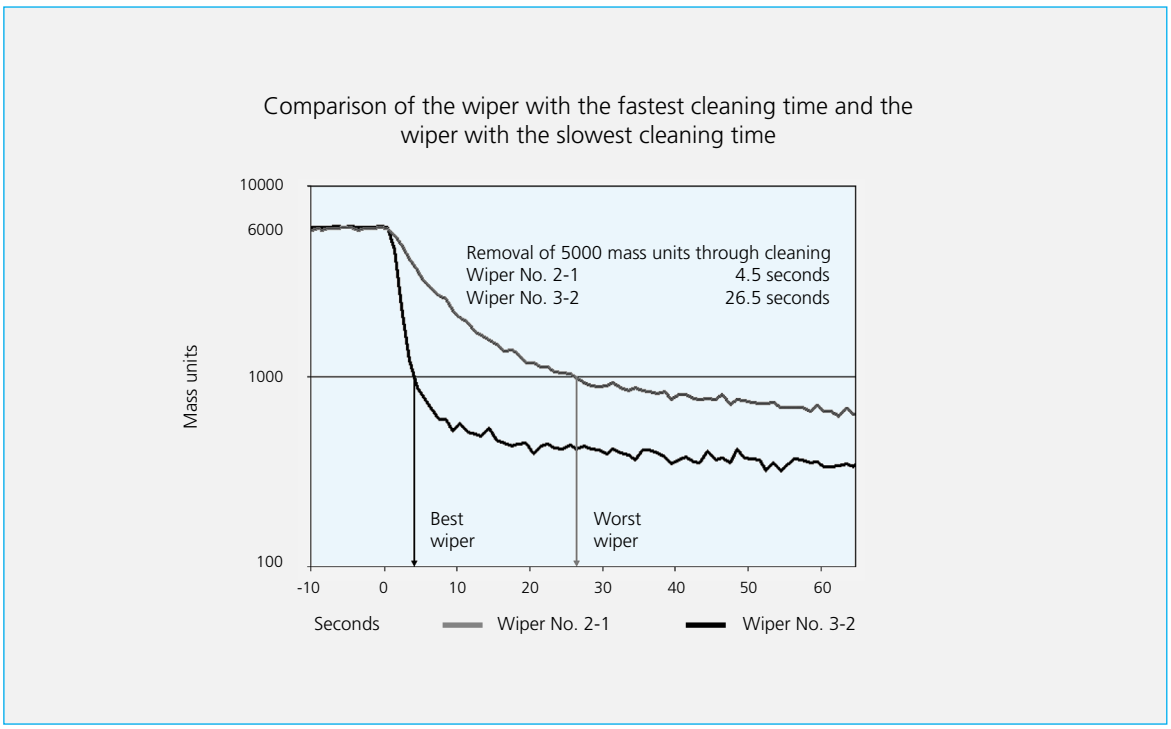

Fig. 1 Comparison of the wiper with the fastest cleaning time and the wiper with the slowest cleaning time

	A - in a dry state		B - impregnated with DI water-alcohol (70:30)		C - impregnated with pure alcohol	
Cleaning wiper (product code)	Cleaning time in s for 5000 mass units	Contaminant residue in %	Cleaning time in s for 5000 mass units	Contaminant residue in %	Cleaning time in s for 5000 mass units	Contaminant residue in %
Nr. 1-1	11.7	6.2	6.5	5.64	80.3	11.3
Nr. 1-2	7.5	5.1	15.2	7.54	41.8	9.3
Nr. 2-1	4.5	4.6	4.5	4.24	11.8	5.5
Nr. 2-2	9.5	2.9	N/A	N/A	N/A	N/A
Nr. 3-1	22.8	7.9	15.9	8.28	71.7	10.6
Nr. 3-2	26.5	8	24.1	8.84	90.7	12.8
Nr. 4-1	3.8	4.1	5.3	5.33	28.5	7.8
Nr. 4-2	12.5	6.2	5.1	5,32	33.5	6.9
Nr. 5-1	4.2	4.3	5.3	5.96	42.5	9
Nr. 5-2	14.8	7.1	10.7	6.71	40.5	9.2

Table 1 SpSpecific cleaning time and maximum cleaning performance (as a contaminant residue in mass units) for ten randomly selected wipers known in Germany, in different degrees of impregnation.

carried out in the dry state and then with IPA (isopropyl alcohol)-impregnated wipers.

Due to the time values listed in Table 1 for the cleaning procedures with various wipers and degrees of impregnation, it has now become possible to classify fine and precision wipers into three or five performance categories (Table 2 a and b).

Layers and particles as common c ontaminants

In some technical systems, particulate contaminants also influence their functionality. Tests made using the Labuda Wiping Simulator Mark III as well as fluorescent and electron microscopy showed that with the removal of part of the layered contamination, the quantity of particles was also significantly reduced. The tests also showed, however, that after repeated cleaning procedures with respectively unused wipers, part of the particles remain bound to the surface and cannot be further reduced using cleaning-by-wiping procedures beyond this range.
The obtained results suggest that some particles are already embedded in the organic contaminant layer; other particles without adequate adhesive forces are deposited on the surface. Some airborne particles land randomly on the layer surface by means of their electrical binding forces. These particles on the surface are removed by the shear displacement forces of the cleaning-by-wiping process and find a new resting place on the fibril surface of the cleaning wiper. Further experiments are needed to confirm this hypothesis.

In addition to the above-mentioned results, the study provided two other interesting findings: (1) In general, knit wipers have a higher cleaning efficiency than nonwoven wipers and (2) alcohol-impregnated cleaning wipers do not clean small amounts of organic contaminants such as thin oil and grease layers consistently better than dry wipers.

Katja Habermüller

Author of the article discussed here:
Win Labuda

Classification of efficiency	Contaminant residue in %	Cleaning wiper (coded)
Class 1	1 - 2.49	
Class 2	2.5 - 4.99	2-2, 2-1, 2-4, 4-1, 5-1
Class 3	5 - 7.49	1-1, 1-2, 4-2, 5-2
Class 4	7.5 - 9.99	3-1, 3-2
Class 5	> 10	

Time classification	Cleaning time in seconds	Cleaning wiper (coded)
Class A	0.1 - 4.9	2-1, 2-4, 4-1, 5-1
Class B	5.0 - 9.9	1-2, 2-2
Class C	10 - 15	1-1, 4-2, 5-2
Class D	15 - 20	
Class E	> 20	3-1, 3-2

Table 2 a+b Classification of the cleaning wipers in the dry state according to cleaning time and contaminant residue (cleaning efficiency)