

# On Win Labuda's Essay

## Cleanroom Consumables – Aspects, Simulation, Arguments

A Review by Thomas von Kahlden



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Before me is a forty-page scientific exposition on the topic of cleanroom consumables. The work – as it must be called – is extensive, and such an extensive treatment of this topic in the German-speaking world has not been available before. I would like to thank the author Win Labuda for

giving me the opportunity to write this review. First, I will present several important sections of the work in which I am in principle agreement with the author's exposition:

- From my day-to-day consulting practice, I know that the topics of cleanroom gloves, cleanroom wipers and clothing in the companies are discussed again and again. However, I do not know of hardly any production facility in which a really knowledgeable selection of cleanroom consumables has taken place. Especially in the use of cleaning wipers, this would be urgently necessary in many cases.

- Furthermore, I completely agree with the author that cleanroom consumables normally do not lead to massive rejects in the clean production process. If this were the case, production and quality control would react immediately.

- Although cleaning wipers and gloves are required in any cleanroom production, the users' knowledge about the contaminating effect of these materials is generally low.

No other institution has dealt so intensively with the issue over the years as Win Labuda, his wife Yuko and the employees of the Clear & Clean Research Laboratory. This longtime

experience is reflected in his essay, and especially in the test methods that Labuda has conceived over decades.

Labuda has made it very clear that hardly any cleanroom user assesses the consumables used to be so critical that he fears that these could cause serious losses of his production yield. One or the other exception may be allowed here. But once this case occurs, it can be helpful to gain a deeper knowledge of the physics of the available materials and processes in order to achieve an optimisation.

Of course, using all kinds of "tormenting techniques" – super-intensive test methods – you can achieve an impressive particle release from the consumables.

However, you must ask yourself whether and to what extent this particle release reflects the usage stress of cleanroom consumables and if not, whether such a test really helps the respective user. Such test methods themselves need to be tested.

In this context, I see Labuda's essay as a milestone, at least as a great step forward on the way to a reality-adapted testing technology for cleanroom consumables. However, we have still not reached the end in elucidating these topics - if there is any end at all. Technologies exist that will pose extreme challenges for us in the future. Here I mention the extreme ultraviolet lithography (EUV) in the technology of the semiconductor industry, the great need for knowledge in nanotechnology, but also problems arising from the inadequate measurement technique for particles on rough surfaces. All this makes it necessary to stay on track in the investigation of the contamination parameters.

In this context, the film contamination discussed extensively by the author plays a much

greater role than in the estimation of many experts whose focus is mainly on particulate contamination. An impressively simple method in connection with the presentation of film contamination from cleanroom textiles is the C&C Transfer Method with its trace imprints and/or liquid residues on a reflecting indicator plate. Such a simple test method with immediately available plausible results is certainly of great use to us all.

However, if you look at the wide range of test methods developed by Labuda, I recall the demonstration of his rotation wiping simulator Mark III at one of the cleanroom lounges, which was symptomatic of the entire test technology developed by the author. The visitors stood there and were amazed at the well-functioning cleaning efficiency test station, but it became clear that only a few of them recognised the testing possibilities of the system developed by Labuda. The problem is probably that the user is not aware of the highly complicated physical and chemical technology underlying the concept of cleaning by wiping. Many even do not know that there are technical data for cleanroom wipers – as for every high-tech product – which characterise their various technical properties in detail. This will certainly not change quickly. But as the well-known textile scientist Peter Ehrler stated in a laudatory speech: „It is indisputably to Labuda's credit that the cleaning rag has over the years become a high-tech product.“

Labuda's observations on the effect of particles in manufacturing environments and their sources are mainly related to particle sizes smaller than 0.5 µm. But the production environments are subject to constant change. Today there are production areas in which humans play a role as contamination source. This is above all the case when people work in the immediate vicinity of the product. Labuda unfortunately does not discuss this in his essay.

Today we need to differentiate between manufacturing under clean conditions such as in the automotive industry, where relatively large particles of 50 to 1000 µm are impor-

tant and, for example, the manufacture of 10 nm structures in the semiconductor industry. This expansion does not make the issue of contamination control any easier, even if in the view of the author and the reviewer large particles can be better controlled than small ones. But the challenge is to develop practice-related testing and evaluation methods for the entire range of consumable applications. Comprehensive coverage of the entire range of testing requirements is certainly one of the prerequisites for establishing new methods on standards and directives in the European and international arena.

In addition to the detailed nature of the essay, it is also admirable how meticulously Labuda has researched the relevant reference literature. Thus, also through the list of references, this essay takes the form of a complete scientific work. As was said, the essay is a significant contribution to the cleanroom technology of our time, which accurately, thoroughly and almost exhaustively documents the state of technology in the areas selected by the author.

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