



Fig. 1 Win Labuda in Jan. 2023
(© daughter Nadja)

Win Labuda

A veteran of cleanroom technology turns 85

*A conversation with Dr. Roy Fox and
Dr. Heiko Baumgartner for the GIT Rein-
RaumTechnik Anniversary Edition, Wiley-
VCH Verlag May 2023*



Fig. 2 My grandfather, the Gdańsk shipbuilder, passed on his affinity for technology to me. (photo 1941)

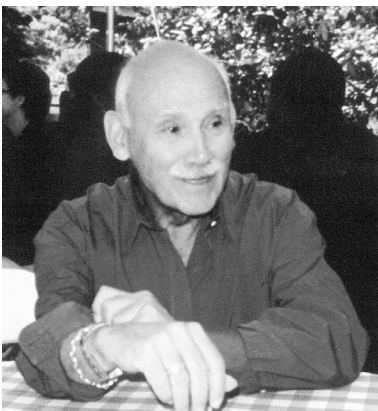


Fig. 3 In gratitude and in good memory: Mr. Edward Paley, founder of Texwipe Inc., who brought many ideas to our industry.

On the occasion of his 85th birthday, Dr. Roy Fox and Dr. Heiko Baumgartner from GIT ReinRaumTechnik spoke with Win Labuda, from whom we have been able to publish a total of 37 specialist articles since the founding of our magazine in 1998. He has actively accompanied the cleanroom technology industry for 50 years and has significantly shaped it through his research contributions and patents, his committee and lecture work as well as his compelling entrepreneurship.

Mr. Labuda, starting in 1974, you worked as a freelance distributor for the American Texwipe Inc. for 7 years, building up their export to Germany. In 1981 you then started to manufacture your own HiTech cleaning products in Lübeck with your Clear & Clean GmbH – after the company was founded in 1979. What made you take this step back then, and how has your company developed over the years?

Win Labuda:

- In 1973, the Siemens purchasing department in Munich asked us to supply them with textile sleeves for the scheduled maintenance of Siemens storage disk devices. They would not have found a suitable provider in Germany. So we researched and found a small US manufacturer, Texwipe Inc. in New Jersey, at that time a company with 6 employees, whose products we imported from then on.
- Business with Texwipe products was doing well, so I paid the company a visit the following year. Edward Paley, the company's founder, shared with me his vision of the growing need for cleanliness in the HiTech industries: the structures of HiTech products, particularly semiconductors, would become smaller over time, while the contaminants – dust, skin debris, and grease films – remained the same size. Entirely new industries would emerge from this reality. In addition, the field micro-cleaning by wiping was practically unexplored, so that there was a high need for gaining understanding in the new markets.
- I was fascinated by his future-orientated vision and decided to devote myself primarily to technologies for cleaning and maintaining cleanliness in the HiTech sector from that time on. In 1974 we became the first distributor for Texwipe HiTech products in Europe. The relationship ended after 7 years for two reasons: Firstly, Texwipe didn't want to give me an exclusive distributor-contract for Germany at the time and secondly: I wanted to test our abilities as a manufacturing company, to design machines and testing devices and developing product-specific analytics. We later became the first European manufacturer of knitted wipers for the techniques of pure work.

- Regarding corporate development: A senior Infineon employee once said, jokingly, about Clear & Clean: „Research laboratory with attached production but without field service.“ That’s probably the closest thing to it. We knew how to ignore the expansion-oriented spirit of a certain time period and focus on top products, special developments, knowledge building and product-specific analytics. We manufacture our products in our “Clear & Clean-Ostseewerk” in Lübeck and have had an average of less than 2 complaints per year over a 10-year average period. Our sales prices are, of course, a little higher than those of our East Asian market competitors, but our customers did not experience a single delivery failure during the Corona period. But it is also true that we must grow now in order not to fall behind.

You put a lot of research effort into your early years and invested a great deal of time and money in basic research for the wiping cleaning procedures. What are the reasons for this commitment and where does your love of science and technology come from?

Win Labuda:

- Let’s start with your second question: When I was 12 years old, my father – a Hanseatic merchant – gave me the book „Metall“ (Metal) by Karl Aloys Schenzinger. The author describes the life and work of the great scientists, inventors and discoverers from Antoine de Lavoisier (1743-1794) to the aviation pioneer Hugo Junkers (1859-1935). I was fascinated by the content of the book and also by the experiments described as an interesting way of knowledge acquisition.
- My grandfather (Fig. 2) was a Gdańsk shipbuilder, for that time a top technologist, who was born in the 19th century and worked as a shift foreman in the construction of the most modern passenger ships at the Schichau shipyard, such as those with a length of up to 233 m and 40,000 hp drive power. He became my role model in striving for technical perfection and discipline. It was probably his genes that transmitted his joy in inventing and building to me. While he was apparently fascinated by large-scale technical objects, I developed an affinity for the micro-world and for documenting everything that is invisible to the human eye.
- Back to the first part of your question: At that time, setting up a production facility for HiTech cleaning wipers was within the scope of my financial and mental capabilities. In addition, three fortunate circumstances coincided: Firstly, I was always interested in flat products such as paper, foils and textiles, secondly in microscopic measuring technology and thirdly in automated series productions. What I now do professionally was and is absolutely my thing and I still feel very

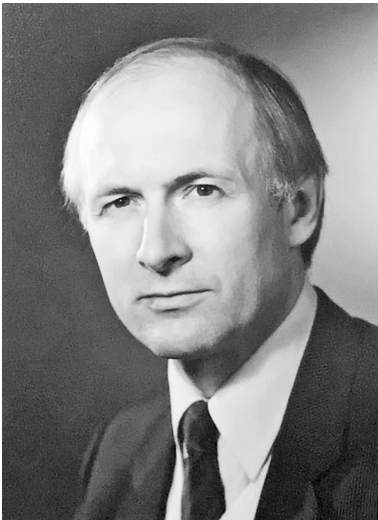


Fig. 4 Our “valiant Swabian”: Labuda’s friend Klaus Schöttle has had a decisive influence on our testing device development.

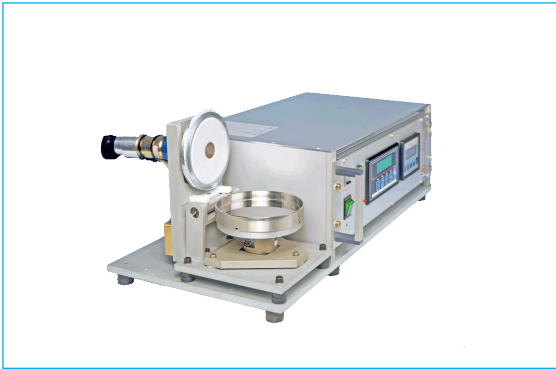


Fig. 5 Labuda dish method, rotary-wiping simulator Mark II according to Labuda/Schöttle for determining effective particle abrasion.



Fig. 6 Rotary wiping simulator Mark III according to Labuda/Schöttle to determine the cleaning effectiveness of different wipers.

comfortable with it even at my age today. And one more thing: Many have helped me. Thanks!

What has changed the most in the area of wiping cleaning?

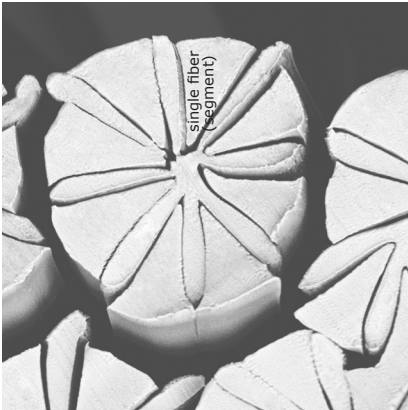
Win Labuda:

- Over the years, there have always been interesting innovations in the HiTech cleaning wiper product group, with Clear & Clean also making a contribution.

- 1970 Wiping cleaning becomes machine-ready thanks to textile tapes wound in rolls.
- 1984 Clear & Clean supplies Siemens with PTFE high-temperature felt rolls for cleaning the drums of high-performance selenium drum printers.
- 1988 Texwipe introduces the first synthetic knit wipers with a sealed edge.
- 1990 Clear & Clean is the first company to produce cleanroom interfolding wipers from PET cellulose for single wiper dispensing.
- 1990 Berkshire (Amber) patents 2-ply wipers directly from the knitting tube.
- 1992 Contec introduces solvent-soaked wipers in resealable polybags.
- 1994 Clear & Clean puts its first laser cutter into operation for formatting knitted wipers.
- 2000 Texwipe introduces aquatic ultrasonic decontamination (Vertex Process) for HiTech cleaning wipers.
- 2000 Clear & Clean offers soaked wipers in reusable containers as an alternative to the polybag.
- 2015 Clear & Clean develops cleaning cards with a precision wiping head.
- 2020 Clear & Clean develops a collector plate, among other things to visualize cleaning effectiveness and surface contamination.
- 2021 Clear & Clean invests in ultra-trace analytics for surface cleanliness in satellite technology.
(the years are approximate dates from memory).

...and what should change?

- An example of a necessary change: The number of suppliers of clean technology consumables has multiplied over the past 50 years. The manufacturing sites have shifted towards East Asia. From there, the pure technology consumables may already be provided with the customer's packaging and company logo, e.g. for delivery to the USA. But: For HiTech cleaning wipers, the US test specifications do not yet contain any information on cleaning performance relating to surface cleanliness. And if it did, then in many cases the respective manufacturer/importer would hardly be able to check it



10k times

Fig. 7 Electron microscopic sectional image of a single matrix filament in the yarn strand of the HiTech cleaning wiper type MICROWEB®-UDG (image width 22.4 μm).

for lack of special equipment. And even if they could verify them, when applying the IEST-RP-CC-004.4 paragraphs 7 and 8 (recommendation), they would come across some test specifications that are erroneously conceptualized.

- It would certainly be interesting to investigate why the American test recommendations of the IEST-RP-CC 004.4 paragraphs 7 and 8 do not contain a surface-based test of the particle release from the wiper to the object surface, or the cleaning performance of HiTech wipers. Is this because the big East Asian wiper manufacturers reject surface-based testing methods? Maybe also because surface-oriented particle measurement technology is not that well developed there? Be that as it may, the fact is that the cleanliness of the object's surface is the goal of any cleaning procedure and not the cleanliness of the wiper. The subject lends itself to change.

You also put a lot of effort into quality assurance and sometimes test your products with the same high-quality equipment that is used in research. Is that really necessary? Couldn't you simply have the production process tested and certified?

Win Labuda

- You're probably right when you think of the many traditional industrial HiTech cleaning tasks that are part of standard cleaning in today's HiTech industries. However, this is not our only future target group. In addition to the standard applications – from which we make our living – we also want to be present where the production and provision of ultra-clean surfaces is concerned, such as in EUV lithography, heavy ion research and in the measurement tasks of the German national metrological institute (PTB), where the new original kilo rests on a Clear & Clean wiper. Testing is a great way to learn about the fringes of existing technology. We then make this knowledge available for use in higher-quality production tasks.

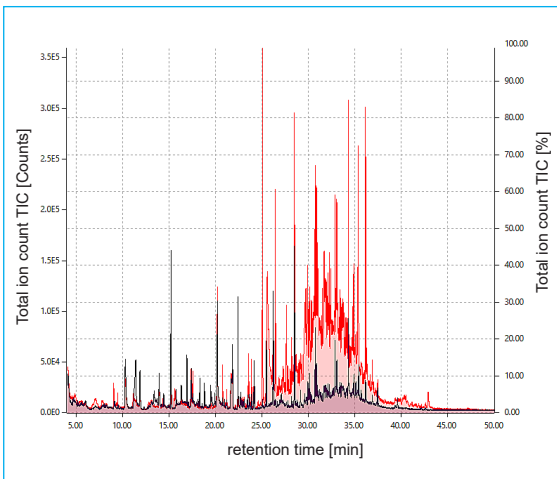


Fig. 8 Purity test of cellululosic raw material from China (red) and Europe (black), determination using GCMS, example from our QC work.

Has the pace of innovation changed over the past 20 years? Computing processes are becoming faster and faster. Communication is also accelerating, but is often worse or less precise.

Win Labuda:

- That depends entirely on the particular area of innovation that you are targeting. The speed and performance of computers depends on the number of transistors in the chip. In semiconductor technology, for example, the rate of innovation has followed what is known as "Moore's Law" since 1970, which states that the number of transistors per chip doubles every 2 years. This prediction by Intel co-founder Gordon Moore (1929-2023) was confirmed by 2020 (source: INTEL).

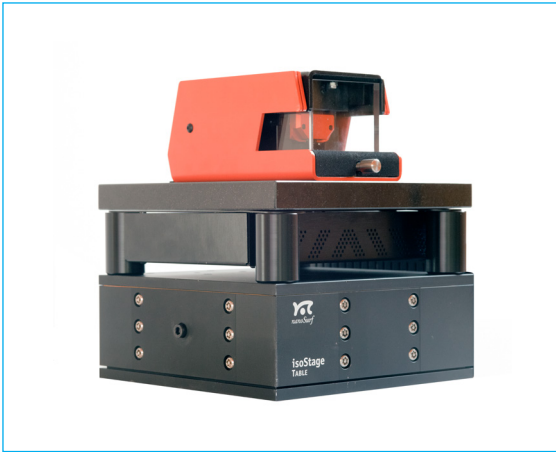


Fig. 9 Atomic force microscope for displaying nano-structures such as surface damage (see lecture publication no. 31 Win Labuda).

- The situation is completely different for a synthetic micro-yarn product: the synthetic PET/PA micro-yarn has long since achieved an average diameter of 4 μm and below for the monofilament. A further reduction in diameter made little sense for the wipers and procedures of wiping cleaning, because this would reduce the operational height of the meshes in the textile fabric and thus also the trapping effectiveness of the yarn for particles in the Feret diameter, which is interesting from a wiping point of view, range from 0.5-3.5 μm (see SEM image, Fig. 7).

You have summarized your previous research and publication work in a book that is to be published for your birthday. What can the reader expect and where can it be obtained?

Win Labuda:

- „On the purity of functional surfaces“ is a book in which my co-authors and I have summarized in 20 chapters large parts of the knowledge we have gained since 1985 and also recently acquired on the topics of cleanroom consumables and surface cleanliness. The content of the book is divided into 3 major blocks: I – Cleanliness-oriented measuring and testing technology, II – Procedures of wiping cleaning, III – Consumables of clean technology. The book will initially be available in a 4-hole ring binder from Clear & Clean in Lübeck at a price of €247 including delivery. This has the advantage that updated chapters can be replaced in their entirety. However, it is planned to publish the book in bound form once all the comments have been processed. The proceeds from the sale of the book go to one of the children's aid organizations.



Fig. 10 CC 902 Microlite scattered light particle visualization with built-in, battery-operated high-intensity LED for many types of visualization of particles and organic films in oblique light, also under the transmitted light microscope.

- I would like to sincerely thank my dear editor, Dr. rer. nat. Heinz Josef Kiggen and the head of the Clear & Clean quality and research laboratory, Mr. Christian Wendt, for their intensive collaboration on this "opus magnum". Without their commitment, this book would not have come into being, at least not to this extent.

Already 20 years ago you wished that users in industry would become more aware of the follow-up costs of using consumables and that they would focus more on innovative products. Has your wish come true?

Win Labuda:

- Unfortunately, the fulfillment of this wish was thwarted by the hype surrounding cheap cleanroom consumables that has come over to us from East Asia for decades. In the wake of this development, the users were seldom inclined to pay increased attention to the quality or the effectiveness of cleanroom consumables. Purchasing departments of large cleanroom ope-



Fig. 11 The Clear & Clean-Ostseewerk (Baltic plant) in Lübeck is located on a 1.2 hectare industrial site directly on the Trave River.

rators have only recently taken on the question of what they are actually buying. They are beginning to learn that while HiTech cleaning wipers may look similar to Chinese quadruplets, they can have very different property profiles.

- We have purposefully invested in modern equipment over the past 10 years, for example to be able to analyze particulate contamination from the environment, surfaces and wipers in the nanometer range down to 5 nm. For the molecular range we have an atomic force microscope at our disposal. For the micrometric range, we use scanning electron microscopy with EDX for material analysis. Our GCMS analysis allows us to precisely determine the outgassing of wipers in the trace range. We use our new 2ppb TOC analysis e.g. to determine the organic wiper contamination. We believe that in the field of cleanroom consumable analysis, we are currently unsurpassed.

What innovations is Clean & Clean working on today and what new products can we expect in the future?

Win Labuda:

- With CC-Microlite®, we recently presented a handy, inexpensive and effective device for oblique light visualization of particulate and filmic contamination. The device can also be used to visualize and photograph impurities in evaporating media such as solvents and alcohols down to the microgram range. When the oblique light is switched on, particles on the collector surface, e.g. may be looked at under a zoom microscope, photographed and counted. Assuming suitable software, also smartphone-supported particle counts, size determinations and classifications would be possible with the device. Targeted contamination of a collector plate and subsequent wiping with a suitable wiper test device also allows the wiper's suitability for removing certain filmic and particulate contamination to be assessed.



Fig. 12 The laying room in the Ostseewerk (Baltic plant). There the wipers are individually tested and packaged in the ISO class 5 cleanroom by Colandis in Kahla

- In the past two years, we have also complemented our HiTech wiper production with a product group: Swabytex® analytic wiper substrates in the trace and ultra-trace range. Here we have developed ultra-pure textile substrates which, with an area of 25 × 25 mm² together with isopropanol extraction and GCMS analytics with impurity masses of just 80 ng or less. If the defined section of an object's surface is wiped with a Swabytex® substrate, part of the contamination on the object's surface is transferred to the substrate. With a highly sensitive GCMS system or comparable analytics, the species that were transferred to the substrate during the wiping process can be determined in terms of quality and quantity. The measuring method works more precisely, the greater the mass ratio of the transfer mass to the original gray value mass of the wiping substrate. This seems a major advance in the field of surface analysis of stationary structures with a high surface cleanliness according to specification, such as the various satellite assemblies.



Fig. 13 Reference book „On the purity of functional surfaces“, Win Labuda et al., available from June 2023.

- Another area we are currently working on is the manufacture of special textile wiper shapes for wiping cleaning of conical or cylindrical cavities, such as tubular structures with enhanced cleanliness requirements. The HiTech wipers are not square in shape, but have all sorts of useful special shapes that we are now able to program and manufacture in a production- and user-oriented manner.

The issue of a shortage of skilled workers is ubiquitous. How do you get the next generation excited about your passion? And can we expect a master’s thesis from Clear & Clean?

- We try to bind young engineers to our company by offering them research opportunities that they don’t have elsewhere and by providing competent, friendly and understanding support. We offer them a top laboratory and a free hand in choosing their area of interest. Our R&D manager, who is experienced in looking after students, has supervised two interns in our research laboratory for the past 2 years up to the bachelor’s examination and both completed the examination with an overall grade of 1.3. They are now pursuing their master’s degree. Let’s see, maybe one of them will come back to us to supervise their master’s thesis.

What has surprised you the most during the years in the industry?

Win Labuda:

- What surprised me the most was that the industry never became aware of a situation as described by the four consumables luminaries Bürger, Gommel, Brückner and Käfer (Fraunhofer Institute for Manufacturing Engineering and Automation (IPA) – as of 10 years ago) in their publication „Mehr Sicherheit beim Einsatz von Verbrauchs-Materialien in der reinen Produktion“ (*More safety during use of consumables in pure production*) from October 24.10.2014 they write:

"... The Fraunhofer IPA is increasingly concerned with issues relating to the selection of consumables that are suitable for cleanliness. Due to their large number and often close proximity to processes or products where purity is critical, these materials are to be classified as particularly critical. So far, their contribution to contamination has often been underestimated. Recent studies ⁽¹⁾ demonstrate the immense impact of consumables on the pure production environment, but up to now there is neither generally valid information nor standardized testing and evaluation methods. This deficiency should be remedied as quickly as possible and at the highest technical and scientific level with the help of a powerful industrial association." ⁽¹⁾ No references were listed.)

- Ten years have passed since then and the “powerful industrial association” has apparently given up. And the consumable’s “immense impact” on the manufacturing environment thankfully didn’t materialize.

What else would you have liked to see during your active time or, to put it another way, what would you still wish for in terms of cleanroom technology for the future?

Win Labuda:

- After the scandal in the German automotive industry that began in 2006 showed us that we, industry, must be much more committed to ethical maxims than before, I would wish that with regard to clean technology, the following grievances to be eliminated:
- State-funded institutes are not allowed to carry out any private-sector activities due to the resulting inequality compared to companies in the private sector, e.g. the commercial implementation of technical tests, maintenance services and issuing test certificates for money. There is a number of private-sector test institutions that cannot obtain research equipment against a request form from the German Research Foundation (DFG).
- I would like the chairs in the technical committees to be recruited from university institutes or from technical authorities and not from companies originating in trade and industry. They should be committed in writing to a code of ethics, the spirit of which they are compelled to transfer to the committee members (see, e.g., VDI pamphlet: *Ethische Grundsätze des Ingenieurberufs* (Ethical principles of the engineering profession)).
- Anyone interested should have access to DIN and VDI committee work, at least as a corresponding member (prohibition of forclosure), and the names of committee members should be made public (as with the IEST in the USA and VDI in Germany) and remain public.

At 85 and in view of your diverse interests outside of cleanroom technology, you may no longer devote your full energy to your company. How is the company positioned for the future?

Win Labuda:

- First, a small correction: Until March 2023, I worked at least 8, but often 10 hours a day as CTO for Clear & Clean. Together with my wife Yuko and Christian Wendt, we have aligned the company to modern requirements in the areas of mechanical and chemical analytics as well as research documentation.



Fig. 14 Yuko Labuda, 1st female Managing Director at Clear & Clean for 20 years.



Fig. 15 Christian Wendt, Chemical Engineer and authorized signatory at Clear & Clean.

That was very gratifying for all. We have expanded our quality and research laboratory in such a way that we would now also survive an ISO 17025 accreditation from the German Accreditation Body (Dakks) if we were so inclined.

- It's true that as I get older, I want to devote more time to completing my memoirs and to microphotography. But even now I am unfortunately forced to think in smaller time periods than before. If I should become as old as my father-in-law is now, then I only have 16 years left. So it would be nice if the Lord God could decide to be magnanimous when it comes to granting my precious time.

Mr. Labuda, we wish you good health for the future and that you remain mentally fresh. At the same time, we thank you for this interview.