Rotary Wiping Simulator Mark II

Win Labuda, Volker Hagen

Clear & Clean Research and Testing Laboratory

Instruments Inventory

as of June 2025

Measurement as the basis of knowledge

by Win Labuda

Measuring, comparing and documenting are the basic functions for acquiring scientific knowledge. *Measuring means comparing a measured value with an officially registered unit* (kilogram, meter, etc.) or a contractually agreed reference value. We at Clear & Clean are proud that the 84 existing clones of the original kilogram are kept at the PTB-Physikalisch Technische Bundesanstalt on a Clear & Clean HiTech cloth as a base. The physicists at PTB Braunschweig have recognized a Clear & Clean cloth as the purest textile structure available to date.

We all benefit from the International System of Units SI with the 7 basic parameters (length, mass, time, current intensity, temperature, amount of substance, light intensity) we immediately get a clear result in the measured quantity kg or cm^3, which is understood and accepted by all nations. That was not always so. Historically, metrology - the science of measurement - and standardization - the art of standardization - are important cultural and historical achievements. In the old and middle Egyptian empires, for example, the Egyptian *cubit (Egypt. Meh)* corresponded to the cubit length of the respective king until it was around 3000 BC. Was probably standardized by Pharaoh Menes to 52.4 cm. It is possible that this historical act of standardization made it possible to build the pyramids. The DIN German Institute for Standardization was founded in Germany in 1917. In 2001 there were already 34,500 DIN standards; an increase of 8 norms per week.

But what if something as banal as the liquid absorption of high-tech wipes is to be determined, but the *comfort* of cleanroom overalls? Comfort is multifactorial and therefore there cannot be a single internationally accepted measure for it. All that remains is to wear a sufficient number of overalls by selected production employees and to have them graded after the test period has expired.

DIN or ISO test methods do not exist for almost all technical products. For example, the handling-induced mean particle release from textile materials can only be determined with the help of many individual experiments or a simulator. In our context, simulation means: reproduction of specific reality for the purpose of material testing. Ideally, the model developer achieves a high degree of identity between real and simulated effective forces in his simulators.

Measuring means recognizing the current situation. How exactly a measurement depicts an actual state plays a major role in measurement economy. Sampling and processing of precise measurement data can be associated with a great deal of effort and time, although in many cases only the information offered by a two-point controller would be sufficient to react appropriately quickly and effectively to certain conditions. At Clear & Clean, we meet the need for simplification by manufacturing "LoTech" test devices such as the CC Microlite luminaire, which offer the user practical knowledge based on sensibly used natural phenomena.

This brochure describes the Clean & Clean research and testing laboratory using the instruments available there. It is our ambition to maintain the best-equipped laboratory that can be found worldwide in the field of *clean technology consumables*. We have given our heart and soul and a large part of our income for this since 1986. A test laboratory differs from a research laboratory in that, in the former, tests are carried out primarily to ensure product quality and occupational safety. In a research laboratory, on the other hand, the set of instruments is determined by the requirement to be able to provide information without delay, even in the case of complex questions, at the time of a new measurement task. We want to be both and work hard to get a little better in both disciplines every day.

Literature: B. Brinkmann "International Dictionary of Metrology" 4th edition 2012, Beuth-Verlag.

Content

1- MICROSCOPY

1.1 Scanning electron microscopy (with EDX)

Electron microscope in PC format for images with real magnification of up to 20,000 times. This device can be used to visualise the very fine yarn and filament structures of high-tech wiping agents and other clean technology consumables on a micrometre scale. In addition, traces of contamination can be visualised and their element structure determined by means of energy-dispersive X-ray analysis (EDX). On the basis of the particle morphology and combination of elements, their origin can often be determined in terms of a production error analysis. Most recently, we used this method to document and visualise the biological degradation of high-tech cleaning nonwovens in the soil (natural composting) over a period of several weeks.

1.2 Optical microscopy

For many visualisation tasks in technology and science, light microscopy is the method of choice for solving problems in pure technology. The micro-structures of high-tech cleaning wipes can be visualised very well using various methods. These include, for example, optical particle analyses on surfaces with brightfield, darkfield, fluorescence and interference contrast. In addition, larger surfaces can be displayed very sharply using automatically stitched images, and videos of chronological sequences can be made. The *focus stacking technique* allows us to bypass the depth of field limitations of optical microscopy and to achieve true-colour visualisations with the sharpness that is familiar from electron microscopic images.

1.3 DIC microscopy

The differential interference contrast microscope is particularly useful where low-contrast, layered surface contaminants such as oil, grease and time-dependent haze (TDH) are to be imaged with high contrast. At the same time, differential interference contrast (DIC) can be used to select, count and view individual particles embedded in the surface film.

In the method, optical path length differences in the object being viewed are converted into brightness differences inherent in the image. This leads to impressive, almost three-dimensional imaging. Appropriate filter combinations can be used to precisely determine the contrast and colour of the images.

1- MICROSCOPY

1.4 Atomic force microscopy (AFM)

We use an atomic force microscope to analyse the morphologies and properties of technical surfaces such as wafers, glass, polymer yarns, filaments of ultra-pure wipes in the nanometre range after we have cleaned them in a CO_2 plasma. This method is used, inter alia, to determine the cleaning effectiveness of high-tech cleaning wipes for nano-layers. Another important area is the visualisation of groove formation through wiping cleaning procedures when cleaning sensitive surfaces (see PUB No. 33: *Reduction of surface quality through wiping cleaning - grooves and scratching on functional surfaces*, Lounges 2015, Stuttgart May 20, 2015).

1.5 Auto sputter coater

A device for the automatic coating of non-conductive samples of electron microscopy with gold, gold / palladium, silver and other metals. Gold coatings in particular result in surfaces that conduct electricity very well, enabling sharp SEM images at high magnification scales. The desired coating thickness can be set on the device in the range of 1 - 50 nm. The coating progression is shown on a display. Due to the magnetron head located at the bottom, the device is also suitable for „cold" sample coatings. For all EDX analyses that may follow the coating, it must be taken into account that a gold layer applied to the sample can falsify any gold components that may be present in the sample. Moreover, near the gold line (M) there are also sulphur (K), molybdenum (L) and niobium (L), which can overlay the gold line.

2- CHEMICAL ANALYSIS

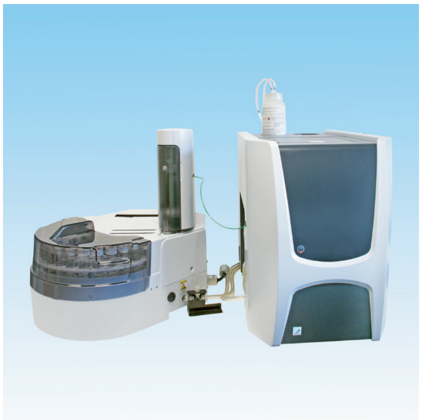
2.1 Gas chromatograph with mass spectrometer

With the gas chromatograph and a headspace autosampler for outgassing analysis, clean technology consumables – for example ultra-pure wiping agents, gloves, overalls and paper – can be tested for outgassing and their constituents chemically analysed in the trace range. Even the smallest traces of outgassing in the ppb range can be measured with these devices and chemically identified using their mass spectra. In this way, undesirable contaminants such as mineral spinning oils, lubricants, surfactants, silicone oils and softeners in textile materials can be identified and weighted according to individual species.

2.2 Solid phase micro-extraction (SPME)

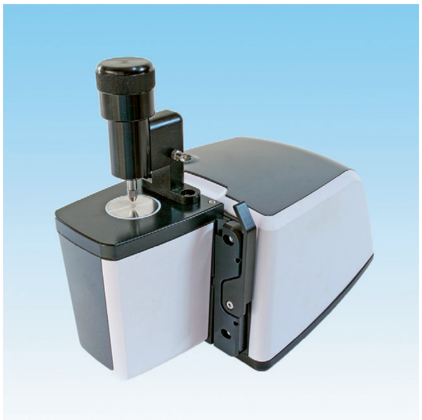
Solid-phase micro-extraction (SPME) according to Pawliszyn is a detection method for determining the accumulation of chemical substances in the ultra-trace range. By absorbing species on a storage thread, the detection limit of a GCMS analysis can be reduced by a factor of 25.
Specifically, we use SPME-GC / MS to determine the total outgassing of high-tech cleaning wipes, overalls, mops and respiratory masks at test temperatures of 25 ° C, alternatively 90 ° C in total. The advantage of the SPME technology is the gain in measurement time that is automatically associated with this technology.

2.3 TOC analyser – total organic carbon



We divide industrial purity validation into an active substance-specific and an active-substance-nonspecific type. (Active-substance-nonspecific means that the individual active ingredients are not shown separately, but are only available as sum parameters). In the active substance-nonspecific purity validation for the analysis of impurities in water such as laboratory water, TOC analysis has become the most widely used method. It is the method of choice both for purity testing of ultrapure water as well as for the cleaning validation of equipment and finished products. This applies in particular if the total contamination as a sum parameter with a detection limit of 2 ppb is sufficient for the set test objective.

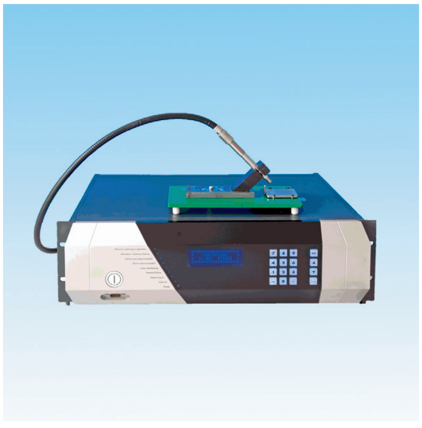
2.4 FTIR spectrometer



FTIR spectrometers are devices for the analysis of organic substances. They enable the chemical analysis of extracts from high-tech cleaning wipes, gloves, overalls, coated papers or other clean technology consumables within seconds. In addition, a test method has been developed in our laboratory which enables the identification of wiping agent residues on surfaces after wiping cleaning procedures. While the transmission FTIR technology is based on the irradiation of a medium in special pellets, it is possible with the aid of the so-called ATR technology (attenuated total reflectance), to analyse non-transparent substances such as oil and polymer layers, paint applications, but also liquid layers, condensates and TDH (time dependent haze).

2.5 Capillary electrophoresis

Device for determining the ion content of porous materials such as cleaning wipes down to the ppm range. The lowest possible anion and cation content of the clean technology consumables is particularly important for semiconductor production and the aerospace industry. That is why we decontaminate our high-tech cleaning wipes using specially treated, low-ion water of 18.2 Mohm quality. The clean technology consumables are first extracted in DI water to determine the ion content and the eluate is analysed by capillary electrophoresis or ion chromatography for the ions present. Capillary electrophoresis is an analytical separation method in a liquid medium to determine charged particles.



2.6 Laser fluorescence measuring device

Device for measuring the fluorescence of organic layers on surfaces (contamination), which is caused by illumination with contaminants or special test liquids with UV light of wavelengths from 266 or 355 nm and fluoresces at 405 nm. This instrument is used for surface analysis and to determine the *cleaning effectiveness according to Labuda*, in which the automatic removal of a fluorescent oil layer by high-tech cleaning wipes from a rotating test surface is measured as a function of time. The laser fluorescence measuring device works in conjunction with the rotary wiper simulator Mark III described on page 18.

2.7 Conductivity meter

The conductivity and the pH value are important basic parameters in the analysis of water samples. We use it to analyse the wash liquors during the aquatic decontamination of our high-tech cleaning wipes. The pH value is a measure of how acidic or alkaline a solution is. While a value of pH 7 means that the solution is chemically neutral, values of 7-14 pH mean an alkaline (basic) environment, and values of 0 - 7 pH mean an acidic one. A highly alkaline wash liquor is desirable in order to obtain a satisfactory degree of chemical washout. For high-purity high-tech wipes, however, a pH-neutral quality – as far as possible – is often desired.

2.8 Microwave extraction system

System for microwave-assisted extraction of chemical components from wiping agents, overalls, respiratory masks and other clean technology consumables. The chemical residues in cleaning wipes and other porous products are often only found there in very low concentration. A microwave extraction system is used to achieve a high concentration of the sought-after species in the eluate. This can then be analysed by means of FTIR spectroscopy, total organic carbon analysis (TOC), GCMS or capillary electrophoresis. A significant advantage of this extraction method is the significant time saving compared to the classic Soxhlet extraction.

2.9 Ultrapure water production

Ultrapure water is the most common and most indispensable medium used in the laboratory for the analysis of impurities. Test water of the highest quality (18.2 Mohm) is required for testing the particle release of high-tech cleaning agents in the daily quality control. We therefore use an ultrapure water system that produces both particle-free and ion-free laboratory water. DI water of this quality can be used as an extraction medium to measure base values for trace analysis in the ppb range.
The water treatment technology comprises:
TOC content <50 ppb
Microorganisms <1 CFU / l
Particles less than 1 particle / ml
Production: 2.0 l / min

2.10 Liquid tensiometer

This device can be used to measure the surface tension of liquids. For this purpose, the force is determined which is necessary to lift a fine platinum wire out of the liquid. Since the surface tension of DI water can be reduced considerably by surfactants and detergents, this method can be used to test wiping agents for such residues by immersion. This is a time-saving and very reliable test method, as the platinum wire can repeatedly be brought into an ultra-pure state by annealing over a gas flame. The measurement time is less than 1 minute.

2- CHEMICAL ANALYSIS

2.11 Precision and analytical scales

Fine and micro scales for the determination of substance content and deposits on surfaces are indispensable instruments in a chemistry and materials laboratory. In principle, there are two different types of mass determination in the µg range: those with a mechanical precision measuring cell and others with a piezo-electric crystal plate. The former also work in the lower µg range. Such instruments are indispensable for the gravimetric determination of filtrates and residues after wiping cleaning processes. Because of the required weighing and repeat accuracy, they are equipped with a temperature control. This allows fingerprints as well as traces of abrasion and material imprints from cleaning wipes, nitrile gloves, etc. to be determined gravimetrically on surfaces of different roughness.

2.12 Soxhlet extraction apparatus

A classic glass instrument for the chemical extraction of textile and other porous materials. The extraction performance of this known process is still almost unrivalled. However, it is time consuming. Therefore, these extraction devices are increasingly being replaced by devices using microwave extraction technology, by which similar extraction results can be achieved in a fraction of the time. The advantage of a Soxhlet apparatus is that you can let the extraction run automatically overnight.

2.13 UV / VIS spectrometer

Spectrometer for the analysis of visible and ultraviolet light. Many organic molecules show absorption bands, especially at ultraviolet wavelengths, which can be used for a direct quantification of compounds in a solution. Using this method, e.g. the concentration of polyester oligomers in a cloth extract can be precisely determined. In addition, a colour reaction was developed for many analytes so that they can be determined indirectly after adding the colour reagent. For example, the concentration of surfactants in water or in extracts can be measured indirectly.

3.1 Counter for airborne particles

In our laboratory there are various laser particle counters for measuring the number and size of airborne particles. The particle counters can be combined with other test equipment (e.g. with the Labuda Walk Simulator) to investigate the release of particles in application scenarios. Particle counting techniques have improved significantly over the past 20 years. First of all, the counting range of many counters today starts with 300 nanometres - even with portable counters. The flow rate / time unit could also be increased from a maximum of 28.3 l / min to a maximum of 50 l / min. For counting the smallest particles in the range of 10 nm, condensation particle counters have become established.

3.2 Portable surface particle counter according to Klumpp

The measuring device is well suited for determining the number and size of particles on surfaces with low roughness. The measurement result is visualised on a live monitor and displayed numerically. At the same time, a printout or data storage on a USB stick takes place. The measuring principle corresponds to ISO 14644-9. The measurable particle size is limited to a Feret diameter of 2 µm in the lower range and ends at 2000 µm in the upper range. The active measuring area is 5 x 7 mm with a measuring time of <5 seconds. Because the measuring range is limited to 2 µm, the counter is only suitable to a limited extent for assessing the use-related *release of particles* from clean technology consumables. On the other hand, it is well suited for assessing the release of fibre fragments from textile materials.

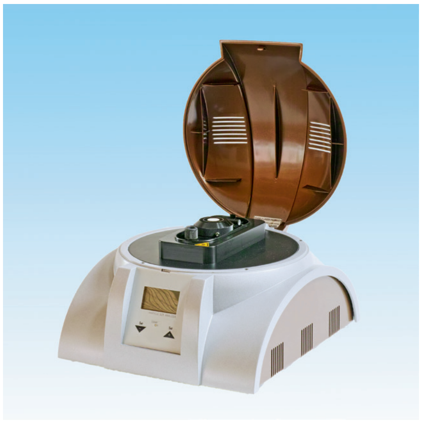
3.3 Liquid particle counter

Laser liquid particle counter for testing the release of particles from wiping agents and other clean technology consumables such as gloves, mops and paper after liquid immersion. With this technique, the number and size distribution of particles in test liquids such as DI water or DI water-alcohol mixtures can be analysed quickly and easily. Liquid particle counters are among the most important quality assurance devices in clean technology. The counter in our laboratory works in the particle size range of 0.5-350 µm Feret diameter. The test volume is generously dimensioned at 1-10 ml. The concentration range of the counter is 0-9,000 parts / ml. Liquid extraction begins automatically after a suction cannula has been lowered into the sample vessel.

3- PARTICLE ANALYSIS

3.4 Counter for airborne nanoparticles

This instrument extends the range of our determination options for airborne particles down to approx. 5 nm. It is therefore now possible for us to measure the release of nanoparticles from high-tech cleaning wipes, gloves and papers. Particles of this order of magnitude are lung-permeable. Therefore, it makes sense to directly determine the lung deposited surface area (LDSA) of the released nanoparticles. This device is of particular importance against the background of the intensive research activities that have taken place everywhere in order to assess the degree of risk posed by nanoparticle concentration in the air at the workplace.



3.5 Nanoparticles in a liquid medium

The distribution and size determination of nanoparticles in liquid media is a challenge for modern measurement technology. Our aim is to detect the nanometric particle content in the three-dimensional structures of textile and other porous cleaning products. The DLS - dynamic light scattering measuring principle of our analyser is based on *Braun*'*s movement*. The *particle mobility* can be calculated from the fluctuation of the scattered light intensity, and the *particle size* can be calculated using the Stokes-Einstein formula. The device enables particle size determinations from the lower nanometre range to hydrodynamic diameters of a few micrometres. The sample is applied directly to a glass surface as a liquid layer of a defined thickness.

4- SURFACE ANALYSIS

4.1 Ellipsometer

The instrument enables layer thickness determinations on test surfaces down to the sub-monolayer range (0.5 to 10 nanometres). This is the only way to measure the effects of wiping precision cleaning with our most effective cleaning wipes (Microweb UDG, Sonit MDH) in the nanometre range. For example, filmic impurities as thin as 0.5 nm can be determined on wafer surfaces. The device is suitable for so-called mapping scans. In this way, informative, nanometric topographies can be graphically displayed in the range of 50 x 50 mm, and the effectiveness of wiping cleaning processes in the ultra-trace range can be illustrated.

4.2 Plasma cleaning system

A continuous supply of energy to a solid matter increases its temperature. It first liquefies before it changes into a gaseous state. With continued energy supply, the atomic shells are broken and a particle mixture of negative electrons and positively charged ions – called plasma – is created. There are always layers of contaminants of a molecular magnitude such as TDH on surfaces. The plasma causes them to dissolve. In purity research, it is not uncommon for coating experiments or procedures of wiping cleaning to start with "absolutely clean" surfaces. Plasma generators and chambers are ideally suited for such experiments. In our laboratory we can check the effect of the plasma cleaning by means of laser fluorescence analysis.

4.3 Centrifugal adhesion analysis

There is a particularly practical test method for the contamination of material surfaces through the use of wiping cleaning systems (cleaning wipe, solvents, handling experience). This is the centrifugal adhesion analysis: A cleaning wipe is wiped over a plasma-cleaned test specimen A surface. This may result in the transfer of traces of the textile chemistry process. After this has been attached to its adhesion partner – a test specimen B surface – by means of a selected adhesive, a molecular structure develops between the surfaces involved, the strength of which is determined by the detachment force during the centrifuging process, which indirectly functions as a measure of purity.

4.4 Quartz crystal microscale

A piezo-electric ultra-fine scale for measuring very small masses such as moisture films and wipe residues in the nanogram range. Layers with a thickness of just a few nanometres can thus be determined gravimetrically. Applying a mass to a vibrating quartz plate changes its resonance frequency, which correlates precisely with the mass. Wiping cleaning processes often only leave traces of contamination on the cleaned surfaces. Piezo-electric scales are well suited for measuring these traces. This also applies to analytical sampling of traces of material by means of lobule removal and subsequent mass determination in the ng range. This requires ultra-pure textile sections that are free of any foreign matter that can be detached from their fibres or filaments.

4- SURFACE ANALYSIS

4.5 Droplet sink time meter

The group of polymers: polyester, polyamide and polypropylene have naturally water-repellent surfaces. High-tech cleaning wipes made from them must therefore be made water-absorbent (hydrophilised) before use. Only then can they be soaked with aqueous solvents. The hydrophilisation takes place through the introduction of non-ionic surfactants into the textile material. This makes the fabric water absorbent but at the same time chemically more impure. It is therefore advisable to determine exactly the right amount for the surfactant input. The *droplet sink time* is the key parameter for determining an application-oriented surfactant mass. The device is also suitable for determining the chemical surface purity.

4.6 Surface roughness measuring device

Roughness is a surface shape deviation that is specified in DIN 4760. It is an important feature when the roughness of a material surface generates more or less material abrasion due to friction against another surface. We measure topographies by diamond needle scanning but also, e.g. in research institutes by non-contact white light interferometry and laser profilometry. The cleaning effectiveness of cleaning wipes, nonwovens and foams is largely determined by the roughness of the surface to be cleaned. ISO 1302 is the valid standard in Germany for specifying the condition of workpiece surfaces. Wipe abrasion tests are carried out in our laboratory on surfaces whose topography is specified in accordance with the above standards.

5- MECHANICAL AND ELECTRICAL TEXTILE TESTING

5.1 Maximum tensile force / elongation measuring device

The tensile strength and elongation of textiles and papers can be easily performed with this device in accordance with the tensile test according to DIN EN ISO 13934-1 and 2. For this purpose, the test specimen is increasingly loaded and the elongation is measured at the same time. The test ends when the test specimen tears. This test is actually intended for fabrics. Nonwovens should be tested according to DIN EN ISO 9073-18: 2008-08 *Textile test method for nonwovens Part 18: Determination of the maximum tensile strength and maximum tensile force elongation of nonwovens* using the grab tensile test.

5.2 Mechanical thickness measuring device

A device for determining the thickness of textile materials, foams and papers. For this purpose, a test weight with a defined contact surface is briefly applied to the test specimen during the distance measurement in order to ensure a high level of reproducibility of the measurement and to ensure that the fibre web on the surface of textile materials does not falsify the measurement in an inadmissible manner. The paper thickness, on the other hand, is determined according to DIN EN ISO 534. A mean value is formed from 20 individual values. The device is also suitable for thickness measurements according to ASTM. The device can be calibrated using a precision feeler gauge with 20 sheets.

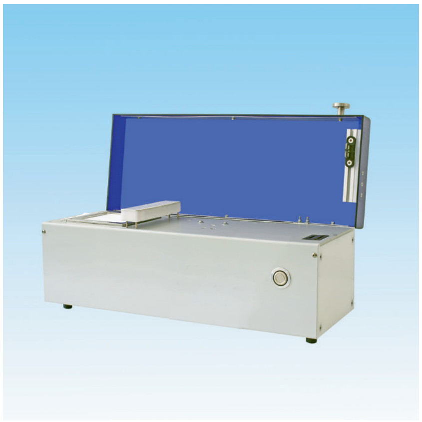
5.3 Electrical surface resistance

The electrical surface resistance of textile fabrics and paper can be a measure of their electrostatic discharge capacity or chargeability. Since the basic materials of high-tech cleaning wipes and cleanroom papers are electrical non-conductors, the resistances involved are very high, up to 10^{15} ohm. For example, this resistance decreases rapidly due to increased ambient humidity. The resistance measuring bridge shown is also used for dielectric tests in connection with the chargeability of porous materials, in particular paper and nonwovens.

5.4 Electrostatic purity measurement according to Labuda

The electrical discharge quotient after a defined electrostatic charge correlates in the case of electrically chargeable textile materials with their chemical purity or their state of leaching. The prerequisites for the measurement are constant material and ambient humidity values. This means that within a defined measuring time, the less electrical charge a fabric loses, the purer it is.

On the basis of this knowledge, our testing laboratory has developed a test procedure for the chemical purity of our wipes. The method was tested in our laboratory for two years on the basis of specifically contaminated test specimens and found to be sufficiently accurate.



5- MECHANICAL AND ELECTRICAL TEXTILE TESTING

5.5 Rotation voltmeter (field mill)

A device for measuring electrostatic fields is described. It works on the basis of the field strength and the surface charge density caused by the influence. At the front of the field mill there is a rotating impeller which periodically opens and closes window openings. In this way, the sensor electrode behind the impeller can alternately charge and discharge due to the influence of the external electric field. The measuring principle makes it possible to take no energy from the electrostatic fields, so that no current flows during the measurement. The electric field strength is measured in volts per metre. The field mill is used to measure surface charges in the vicinity that should normally be avoided: for example, when unpacking electrical circuits from their packaging, which experience has shown can be damaged by even small electrical discharges.

5.6 Climatic chamber

A climatic chamber is a hermetically sealed room in which predetermined climates (temperature and humidity) are maintained over a longer period of time, under the influence of which a technical test is carried out. In many technical tests, the climate under which they take place is of great importance for the accuracy of the test result. Textile materials and paper, for example, change their technical data – in particular their electrical surface resistance – very significantly depending on the ambient climate. We therefore normally test our textile products in a standard climate according to DIN EN ISO 139 at 20 +/- 2 ° C and 65% +/- 4% relative humidity. Before technical products are fully acclimatised, they must have been in the test climate for up to 24 hours, depending on the type.

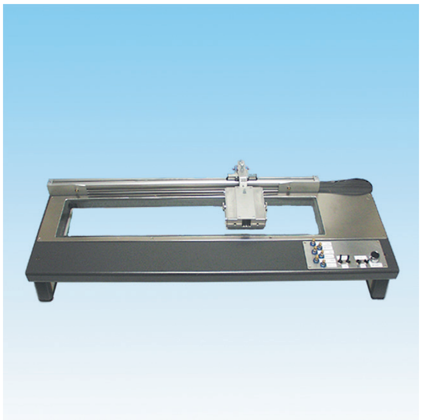
6- PURITY INSPECTION SYSTEMS

6.1 Linear wiping simulator Mark I

Simulator for the implementation of reproducible wiping processes for the scientific investigation of the mass removal of specifically contaminated surfaces. This includes glass, metal and plastic plates as well as various contaminant material. For example, the removal of particulate and filmic contaminants and their transfer back to object surfaces can be investigated in the context of wiping cleaning procedures. The influences of the wiping speed and the vertical pressure on the cleaning effectiveness of high-tech cleaning wipes can also be investigated very well in this way.

6.2 Linear wiping simulator Mark II-A

The linear wiping simulator type MarkII-A with a sliding plate made of glass can optionally be provided with a metallic sliding plate (type MarkII-B). In this plate there is a recess for the fitting of highly pure or deliberately contaminated quartz oscillator platelets. The platelet is compatible with the quartz scale type QCM-200 (see page 14). The targeted contamination of the metallic sliding plate or the surface of the quartz platelet is followed by a wiping cleaning procedure using high-tech cleaning wipes of various types. A special feature of this system is that a high-speed camera can be synchronised with the movement of the test specimen underneath a transparent test surface.



6.3 Rotation wiping simulator Mark II according to Labuda

This simulator was developed by Labuda and Schöttle with the aim of determining the particle and fibre abrasion of wiping agents and foams during wiping cleaning processes over surfaces with increased roughness and special topographies. The principle works with four trays made of V4A steel, the bottom of which have a higher roughness level respectively. The rotor, which is covered with a cloth sample and is under defined pressure, moves in it. After a predetermined number of rotations, the tray with the abraded particles it contains is removed from the simulator and filled with particle-free DI water. The demineralised water is examined for the number and distribution of particles either microscopically or by means of a liquid particle counter.

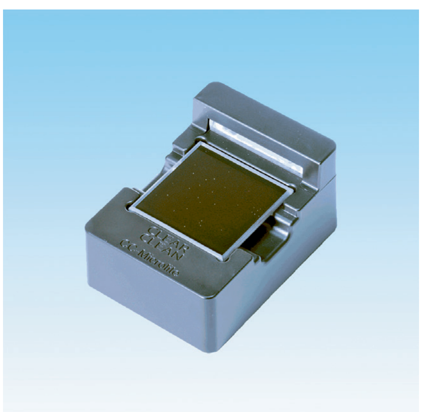
6.4 Rotation wiping simulator Mark III according to Labuda

In 2007, Labuda and Schöttle presented the Mark III rotary wiping simulator, with which it is now possible to measure the cleaning effectiveness of different high-tech cleaning wipes for low-viscosity contaminants (mineral oil). A rotating roller made of VA steel with a defined surface roughness is deliberately contaminated by applying a thin film of oil. The removal of the oil film by a cleaning wipe (test specimen) pressed against the rotating roller is measured continuously by means of laser fluorescence measurement. With the same apparatus it is also possible to determine the cleaning effectiveness of high-tech cleaning wipes per unit of time. For the first time, performance parameters for cleaning wipes can be defined. This means that high-tech cleaning wipes can be classified for example as precision, fine and standard cleaning wipes.

6- PURITY INSPECTION SYSTEMS

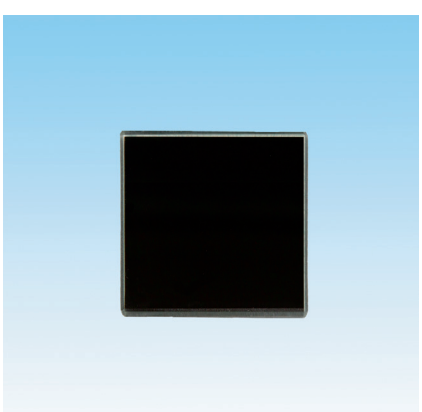
6.5 Walk simulator Mark I according to Schöttle and Labuda

Over the past 30 years, Labuda and Schöttle have developed various simulators to determine the handling-induced release of particles from clean technology consumables. The focus during the development was on the realistic and reproducible simulation of various handling steps for high-tech cleaning wipes and paper. The results can be used to select the right high-tech cleaning wipe for cleaning applications such as wiping over edges and topographically special surfaces. The test with the Walk Simulator Mark I enables cleaning wipes with unsealed edges to be tested in which the release of large particles and fibre fragments makes up a greater proportion of the total particle release.



6.6 Scattered light particle visualisation * NEW *

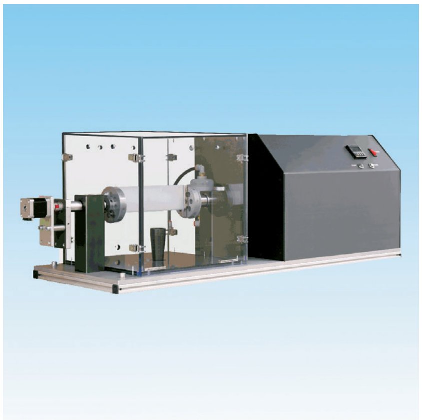
Dual oblique light lamp for the visualisation of particles, fibre fragments and material imprints on collector plates (1) and any smooth surfaces (2). With this lamp, the particle release from various high-tech wipes can be examined quickly and easily. If necessary, the evaporation residue of solvents can also be made visible. The device is ideally combined with the CC collector plate CC 900. The device can also be placed on the stage of a microscope so that the particles, traces etc. on the collector plate can be viewed and recorded photographically or automatically counted.



6.7 CC 900 collector plate

Versatile collector glass plate with black background for the visualisation of sedimentation and imprint particles, filmic contamination, material imprints, drying residues and time-dependent haze. The visualisation can e.g. be done with the light microscope in darkfield, fluorescence or in differential interference contrast. Labuda et al. have described a test method for the CC collector plate with which, among other things, the textile purity of high-tech cleaning wipes can be assessed in the as-delivered condition. The collector plate can also be contaminated in a targeted manner, for example with a thin film of oil or grease, and after a wiping cleaning process, the cleaning effectiveness of the corresponding wiping agent can be analysed.

6.8 Particle Release Simulator



Simulation of the particle release from porous materials such as cleaning wipes by small-angle agitation. Measuring chamber for simulating the particle release of high-tech cleaning wipes and other purity-based textile fabrics under various mechanical stress conditions. The small-angle agitation of the test specimen by +/- 30 degrees at graduated oscillation speeds allows conclusions to be drawn about the release of particles from use. The particle number is determined using different air particle counters down to the nm range.

6.9 Ultrasonic cleaning – testing machine

One possible decontamination method for polyester knitted fabrics for the purpose of producing pure high-tech wipes is ultrasonic cleaning instead of rotary drum washing and drying processes. An American company reports that they manufacture high-tech cleaning wipes made of polyester knitted largely automatically. A European patent (EP2739777A1 - applicant Illinois Tool Works) is in force until July 30th, 2032. We had our ultrasonic testing machine built in order to gain general insight into ultrasonic-supported decontamination processes. After we had already put an automatic web washing and drying system into operation in 2002, we were able to determine more disadvantages than advantages compared to drum cleaning and therefore dismantled the system again. In our view, the same applies for automatic ultrasonic cleaning.

We are often asked by our customers why we actually need such an extensively equipped laboratory. The reasons for this are varied, but are mostly related to the creation of physical and chemical data concerning our own products. And of course the innate enthusiasm for analytics of the company's founder and several of his employees also plays a role.

The main area of application is the quality control of the products we manufacture. For example, a few months ago we made the quality control chart for our Sonit® MDM fine cleaning wipe visible to everyone on the Internet (www.cleanboss.de quality).

Recently, we have also been giving young scientists from Technische Hochschule Lübeck and other universities the opportunity to write their bachelor's or master's thesis in our laboratories using our instruments. In the form of a video conference, our university student Lea E. has just passed her oral exam and completed her bachelor's degree with a grade of 1.2.

A key argument in favour of maintaining such a laboratory is that we primarily supply our high-tech cleaning wipes to users who are unfamiliar with textile technologies. Therefore, they usually neither have the relevant testing technology nor trained textile testers and suitable analytical instruments. Sometimes users of cleanroom technology consumables also have problems with the use of textile consumables (high-tech wipes, clothing, breathing masks). But such problems rarely occur, so that it would hardly be worthwhile for users to purchase special test devices and train test personnel. In such cases, we here at Clear & Clean are glad to provide support.

If necessary, we visit users of our consumables on site and can usually help very quickly thanks to our 40 years of experience. We do not have to familiarise ourselves with the situation first – we already have the equipment, measurement methods and testing experience. This also and especially applies to a whole range of test simulators that we have developed.

Last but not least, we would also like to test what our competitors are developing and have to offer our market. Most of their products are East Asian imports. Their quality does not always have to be inferior, but in many cases it is not subject to continuous quality control with disclosure of the quality data. For these reasons, some German East Asia importers are now starting to set up small test laboratories in their offices and then issue a "Certificate of Compliance".

Today, our product development research is more intensive than ever before in the area of high-end technology. One of our current challenges is to develop ultra-trace analysis for extra-terrestrial applications. So there is always work for our research and testing laboratory!

Clear & Clean

Werk für Reintechnik GmbH
Niels Bohr-Ring 36
23568 Lübeck
Germany

Phone +49 451 389500
Fax +49 451 3895020
Email info@clearclean.de

Werk für Reintechnik GmbH

www.cleanboss.de