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das dental labor

Die ganze Welt
der Zahntechnik

SONDERDRUCK

Vom Pulver zum Rohling

von Angelika Schaller, München



sagemax

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In April, Das Dental Labor's editor-in-chief Dr. Angelika Schaller and Uwe Kremmin visited the firm Sagemax during a USA tour.

Sagemax produces here Zirconiumdioxid Blanks for sale worldwide. We wanted to know how Sagemax operates and see the entire process ourselves: from the delivery of the raw material to shipment to customers.



The manufacturing of zirconia - what you always wanted to know

From Powder to Blank

Sagemax is located in a suburb of Seattle, a friendly city in the northwest corner of the USA. Seattle is where you will find the main offices of large industrial firms such as Boeing, but also is the home to several iron, steel, and lumber companies. The Port of Seattle is an important gateway for business with Asia, Alaska and Hawaii. Seattle is also the home of the 'Space Needle', an architectural landmark built for the 1962 World's Fair.



Sagemax has grown extremely fast. They produce their brand name products but also have several OEM partners worldwide. Since their start in 2006 an approximately 9 Million zirconia restorations have been made worldwide. After their move to a new production facility in 2012, Sagemax is able to produce 15,000 blocks and discs per month.

We saw, what is needed to produce a Blank from powder.



The production process begins with the **delivery of the powder**, of which must be the best quality. Inferior quality powder would negatively affect the end product. Therefore is every delivery thoroughly tested.

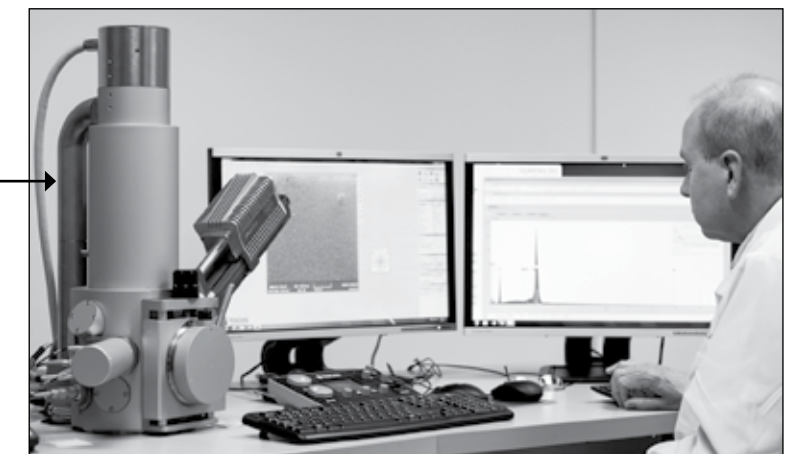
First Test: Radioactivity. A real problem of some powders is that they are too radioactive. It is unthinkable that a restoration made of such a powder be in a patient's mouth. Therefore in the first step a sample of the incoming powder is sent to an external lab that measures its radioactivity level. We learned that these tests are not cheap, but performed on every single powder lot delivery as a vital step of quality control.

Next the **particle size** is measured to ensure that the values are within limits. The powder is combined with a special liquid and analyzed in a 'Particle Analysis Machine'. This machine can measure particle sizes as small as four Nanometers, and provides the range of the particle sizes in the sample.



In the third step of the incoming control the **chemical composition of the powder** is analyzed. Here, Sagemax verifies that the level of elements are correct and that there are no unwanted impurities in the powder.

For this the sample is put into a Scanning Electron Microscope equipped with an EDX analyzer from the firm Bruker. The microscope shoots an electronic beam into the sample, the sample then emits X-rays which are measured and shows which elements are in the sample as well as the amount of each element.





Above is an example of such an analysis. The element names are blacked out to protect Sagemax's special 'recipe'.

The fourth incoming test is where the end product's **flexural strength, color, and translucency** are tested. For this a sample batch of blanks are manufactured from the powder from which several small test discs are milled out of them and polished. First the flexural strength is tested. For this a small test disc is placed in a machine that applies increasing pressure on either two or four points until the disc breaks. The strength that is needed to break the disc is then a measurement for the strength of the disc.

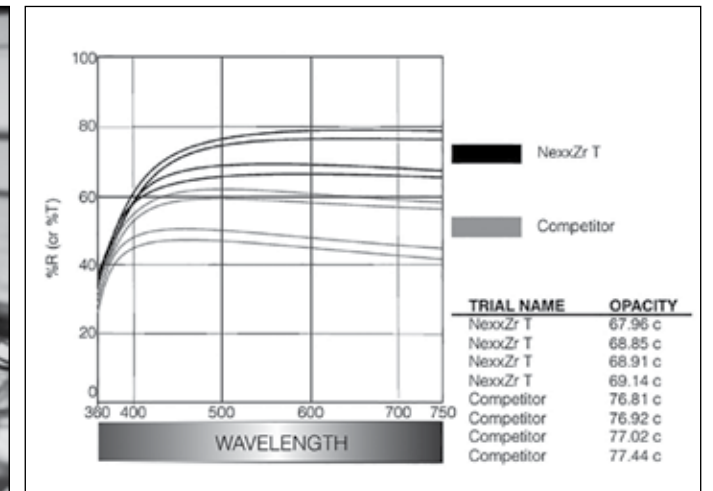
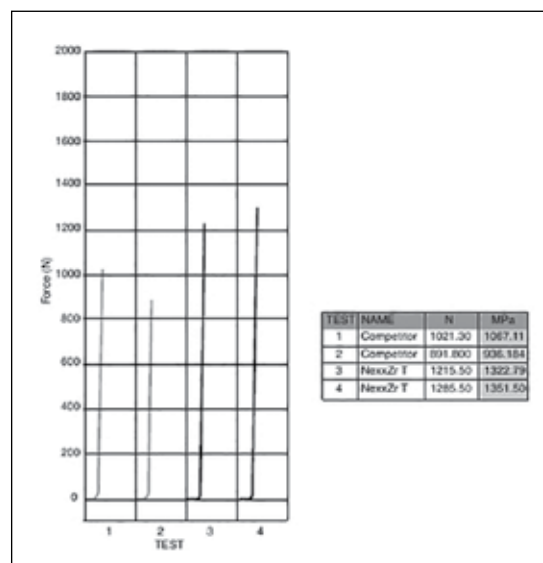
Next the discs are tested to ensure that they have the correct color and translucency.

The test discs are put into a translucency tester, which has a spectrometer which can measure visible light up to UV levels. Every disc is tested twice: first by shooting a light beam through the sample on a white



background, and then again with a black background. The machine then calculates how much light is reflected (with the white background) and how much is absorbed (black background) and which wavelengths are reflected. From this reading it then calculates what color and how translucent the zirconia discs manufactured from this powder will be. According to the owner, this test proves that Sagemax material has the highest translucency in the market.

► Ergebnisse von Festigkeitsanalysen



▲ Translucency Tester

► The translucency in comparison to other products

When necessary two other tests can also be completed, done mostly during the product development phase:

For **aging testing** a sample is artificially aged in a pressurized testing machine that applies pressure, heat and acid. 9 hours in this machine equals approximately 20 years in the

patients mouth. After aging testing the sample is then put through the same tests as listed above.

For the millability testing a pre-sintered blank is put into a milling machine, where, after a certain 'milling distance' the wear on the bur is examined.

The lower hardness of the pre-sintered blanks from Sagemax appears to be well accepted by their customers. Sagemax tries to establish with this test the right balance between millability and strength (so that the material does not chip during milling).

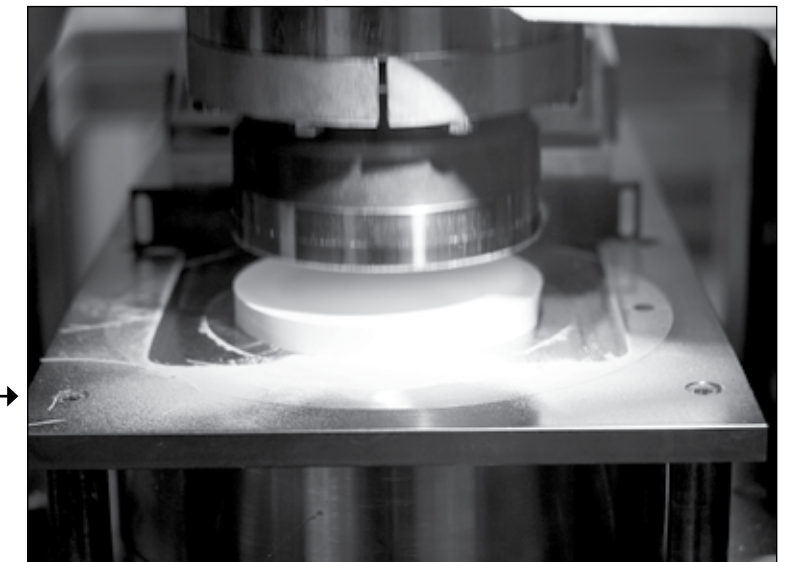
→ Now the production starts

It is Sagemax's goal to produce the highest quality zirconia. Therefore they produce not as fast (or cheap) as possible, but as best as possible states the firm's management. Here they use the best available machines to delivery high quality efficiently.

These are the individual production steps:

Pre-Forming

A press from the firm Dorst (dorst.de) presses the powder, for example, into a disc. A robotic arm takes the disc and weighs it to check that it is correct, and lays it then onto a





carrying tray where it is transported to the next production step.

Cold Isostatic Pressing

Every blank is wrapped in film and placed into an industrial sized isostatic press. The press is then filled with liquid which is then pressurized and presses the blank.



The liquid applies equal pressure to the blank from all sides. This step is important for good zirconia, but also how long and how much pressure is applied is also a factor. These two important factors are done differently by other manufacturers and can result in varying qualities says Sagemax.

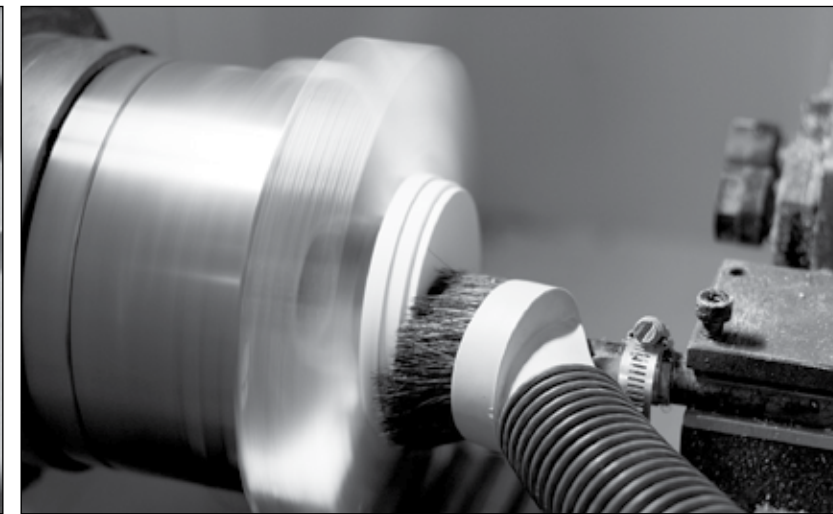


Quality Control

All blanks are then inspected for imperfections and measured. The measurements are needed to calculate the shrinkage factor after pre-sintering.

Pre-Sintering

The pre-formed blanks are then placed into one of seven massive Nabertherm ovens (nabertherm.de). This High-Tech-Oven can exactly control temperatures through a 7-heat-chamber system.



Cutting

After pre-sintering the blanks are placed into a lathe where they are cut into the required shape.

Quality Control and Shrinkage

All blanks are again visually inspected and measured for the calculation of the shrinkage factor.

To finish the blanks are printed and sent out.



The photos come from Travis Leer. We asked him to give us his photos as we saw that he not only had a better camera but is also a good photographer. Travis runs the branch of Sagemax (Sagemax.de) in Berlin. If you want to speak with him you can call him at +49 30 60 98 36 88.

And this is what he looks like:



Our conclusion? We met a CEO – Larry Dang -, that through all of his success stays very modest and is very empathetic with his employees. We saw a research and development department that was engaged, open, and innovative. We met Travis, who showed us his hometown of Seattle in a way that you don't normally get to see. And we saw close up the production of zirconia blanks, that we have now shared with you.

Angelika Schaller

