Humidity has an effect on source materials and intermediate products during manufacture

The Fraunhofer-Institut für Keramische Technologien und Systeme [Institute for Ceramic Technologies and Systems] IKTS Dresden looked into the question, whether humidity has an effect on the source materials and intermediate products during manufacture of carbides for machine tools and tool making.

Tools used in machining processing for drilling, lathing, milling, cutting and sawing, and for non-cutting shaping need to be hard and tough. The first **carbides** for this purpose were registered for patent back at the beginning of the 20th century. Because of their characteristics these materials are today more topical than ever, which is why research and development is concentrated on new compounds of the source materials and on refining manufacturing processes to continually improve the product quality. At the Fraunhofer-Institut für Keramische Technologien und Systeme [Institute for Ceramic Technologies and Systems] IKTS Dresden, a project in collaboration with several **carbide** companies, and under the overall control of the **Carbide** working group in the Powder Metallurgy Professional Association has since the summer of 2008 been examining the influence of humidity in the production of **carbides**. Klaus Jaenicke-Rößler from the IKTS Dresden gives some technical insights.

Carbides: Well-known, but more relevant than ever in **materials science**

Laboratory ovens for materials science

Constant climate chamber HPP

Climatic and temperature test chamber CTC/TTC

Universal drying Oven U

Humidity Chamber HCP

Composition and manufacturing of carbides

As elsewhere, as the quality improves, the demands of economical effectiveness made on **carbides** also increase. Customer advantages can be gained from longer tool downtimes and more precise workpiece processing due to lower wear and tear, as well as a high toughness and impact resistance. Production of **carbides** is done predominantly by means of of powder metallurgy. They are a composite material and consist to a large extent of hard materials such

Humidity has (no) impact on paper

At the Labelexpo 2009 in Brussels, visitors experienced live, through the glass doors of a constant climate chamber, how a new, environmentally-friendly

as tungsten **carbide** and of binding agents which fill out the spaces between the hard material grains during the shaping process (sintering), the size of which can be measured in micrometres, to achieve a sufficiently high degree of toughness for the material. The moisture present here in the raw materials, aggregates and depot atmospheres may in one way or another have a negative effect on technical processes such as grinding, mixing, granulating, shaping, debinding, outgassing and sintering, and thus on the end properties of the product. There is therefore both a material-science and an economic interest in clarifying the reactions and processes triggered by defined **moisture contents**. Here the **moisture contents** in the atmosphere that are critical in particular in the production of **carbides** are of crucial importance when storing source materials and intermediate products. Water is absorbed by the raw materials and intermediate products, depending on temperature, time and the **moisture content** of the atmosphere. During the subsequent debinding, outgassing and sintering process, the loss of this water or of its reaction products with certain material components is associated with calorific effects, changes in weight and sample outgassing, as well as changes in the dimensions of the **carbide**, and has a more or less strong influence on the end properties of this.

Constant climate chamber in today's materials science

Suitable probes for the in-situ observation of these effects are provided by thermal analysis, with methods such as differential scanning calorimetry (DSC), thermogravimetric analysis (TGA) in connection with emission gas thermoanalysis (EGA) and thermodilatometry (DIL). Whereas the Thermal Analysis and Thermal Physics team at the Fraunhofer IKTS had suitable apparatus, extensive knowledge and many years of experience at its disposal to perform the in-situ observations, the appliance technology for the air-conditioned storing needed to be extended. Extensive research led to the acquisition of the **constant climate chamber** HPP 108 with **Peltier technology**. The main selection criteria were long-term stability, reliability of backing stayed dimension-stable, even at different levels of humidity...

more information

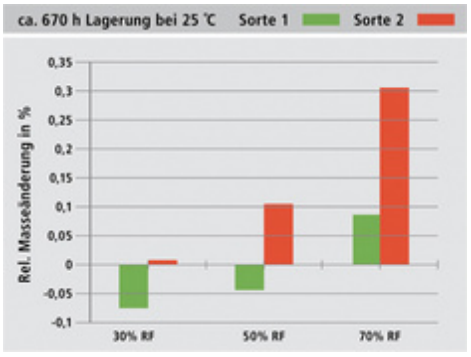
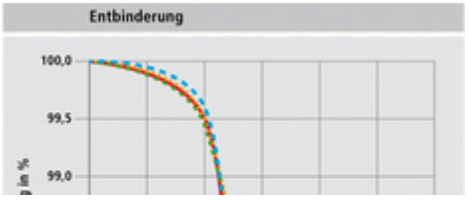


Figure 1: change in weight in carbide types 1 and 2 during long-term storage at different levels of humidity



the control technology, economical efficiency, running smoothness and low noise level. Tests for running in the **constant climate chambers** were aimed at implementing predefined temperature-time and humidity-time levels, and at the control behaviour of the chamber when the double doors were opened and with other sudden load changes, such as the addition or loss of humidity. As was also seen in the assessment of the independent data logger for temperature and humidity, used in parallel, all tests ran satisfactorily.

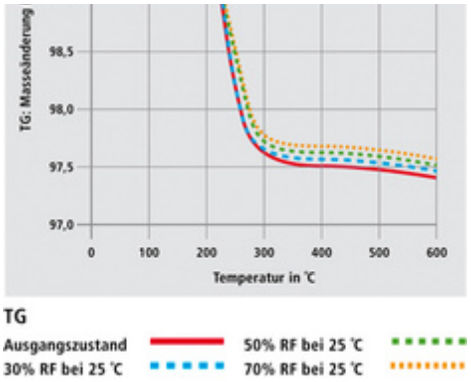


Figure 2: change in weight in carbide type 1 during the sintering process

Moisture Content has impact on quality of carbides

After this the real tests started. The **constant climate chamber** ran steadily and reliably over the entire period. Thus two different types of **carbides** were stored for 670 hours in the form of predried extruded rods at close to room temperature (25°C) under three different relative humidities (30 %rh, 50% rh and 70% rh). Figure 1 shows the influence of humidity on the change in weight. It can be seen that with increasing humidity, the weight increases, as can be expected, but that type 1 surprisingly displays losses in weight for the low and medium humidity. How this behaviour affects the subsequent sintering process can be seen in Figure 2, by means of the TGA graphs of type 1 in the debinding area (temperatures less than 600°C). The discrepancies in the weight loss graphs for materials stored at different humidity levels proves the strong influence of the carbon balance, and therefore of the end properties of the carbide.

Experts in Materials Science: Fraunhofer-Institut IKTS in Dresden

An overview of focus topics

- **Materials science**
- **Tool making**
- **Carbide**
- **Moisture**
- **Moisture content**
- **Constant climate chamber**

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Material scientists, physicians and chemists can come in at this point and clarify the kinetics and the mechanisms of these effects. Reliability in the production-technical process is gained from the result, and in parallel to this the quality of the **carbide** can be selectively improved. The Fraunhofer-Institut IKTS Dresden develops application-based, modern ceramic high-performance materials, industry-relevant manufacturing processes and prototype components. It is one of 57 Institutes of the Fraunhofer-Gesellschaft, the largest organisation for applied research in Europe. 14,000 employees, mainly with a background in engineering or natural sciences, work for industrial and service companies, as well as for local and central government.

Determining moisture content of wood

A research project of the Institute for Musical Instrument Making at the TU Dresden in Zwota and the Institute for Wood and Paper Technology at the TU Dresden shows: Thermally modified timber, that is artificially aged wood, can considerably reduce storage times and costs...

more information

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