CIMTRODE®

SEAGULL
DER GRAPHITFRÄSER

PRACTICE REPORT

GRAPHITE MILLING WET OR DRY?

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A COMPLETELY NEW ASPECT IN GRAPHITE PROCESSING

MILLING GRAPHITE ELECTRODES WET OR DRY – WHAT IS MOST SUITABLE? CIMTRODE HAS DONE COMPARATIVE TESTS IN COOPERATION WITH GF MACHINING SOLUTIONS TO FIND OUT.

The "dry milling" of graphite is everyday's business in the tool and mold manufacturing world. Milling graphite wet however, has been tried many times and mostly it has just been staying that way. In order to shed a light on the subject, we, GF and CIMTRODE, have agreed to a common practice test in order to arrive at tangible comparative values of the two different processing technologies.

The stated goal of the study was to learn about the impact of the two technologies to the cutter's deterioration, how does a electrode reacts that became wet after milling compared to dry EDM machining and what effect causes the mixing of graphite dust with cooling emulsion in the milling machine. We needed to find clear and explicit answers for all these questions.

TEST PROGRAM

For this purpose, we have considered the following experiment: with one and the same milling program is graphite milled on a milling machine Mikron Mill S400 dry, on another Mikron Mill S400 wet, also together with cooling emulsion. The milling is done on both machines with SEAGULL tools.

The milling tools are measured before and after the experiment on a high-precision laser surveying system for concentricity and diameter. For optical control high resolution pictures are made with C-View before and after the processing of the milling tools. To get an exact inference on the deterioration a thickness measurement is carried out before and after processing. The results thus obtained are evaluated and compared. Then both electrodes are put in the EDM machine.

Daniel Gruber, toolmaker and CEO of CIMTRODE GMBH, has spent 20 years in the area of graphite and developed the cutting pressure optimized SEAGULL cutters for graphite machining.

So we started working on it, designed electrodes, wrote milling programs, surveyed and recorded milling tools, set the machines and off we went. The suspense was great.

To be honest: I did not have high expectations that the test would work, after all, I have been milling graphite dry for 20 years now and it worked very good so far. There is also a lot of experience in this area. Electrodes that were already in the dielectric fluid before - also already somehow became wet - we no longer copy-mill, because it simply doesn't work. This knowledge in my mind probably clouded my expectations.

SURPRISING RESULTS

The more I was amazed, when I took the mills we used and examined them under a high resolution camera with C-View for the first time. My first reaction was: there must be a mistake!? Because what I saw was a clear result in favor of the wet-pro-

cessing and this did not fit my expectations. Perhaps the mills were mislabeled, or the programs were not equal, or, or...

Without further ado, we decided to repeat the experiment. This time we watched very picky and exactly that both machines were milling with the exact same parameters and that there could be no confusion at unclamping the cutters.

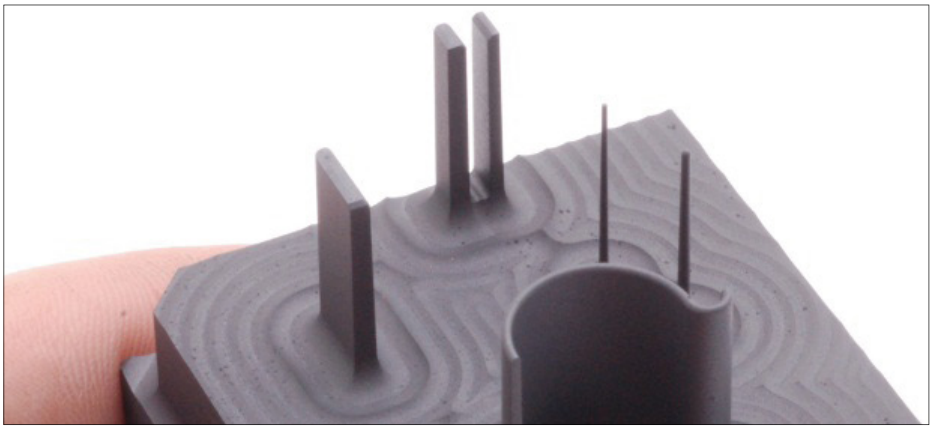
I was surprised because the result was the same. All comparative measurements showed a clear result - again in favor of the wet-processing. The measured differences ranged between 35 and 50 percent. From then on, I knew: this is a serious matter, at least for the cutter deterioration!

TEST EXTENSION

Now I wanted to know for sure. With my years of experience testing graphite mills, we went back to work and extended the trial by several variants:
So we milled extremely thin struts and ribs to find out if a jet of water at high pressure might be damaging. As a result: there was no damage. All struts and ribs remained (picture above).

We increased the material engagement time per cutter from 290 to 490 minutes, to learn how a cutter behaves in the threshold.

The result: in this experiment, the differences are most apparent. The diamond coating of the cutter in the dry processing



is pushed to its limits after 490 minutes engagement time, despite optimized air supply directly to the milling location (see figure below). Compared to this result, the cutter from the wet processing is in still fairly good shape after 490 minutes operation time (see figure below).

The wet milled electrode was still in a minimum deviation window of 0,005mm and the surfaces produced were still optimal. Whereas the dry milled electrode has significant deviations and with this surface quality would be sufficient in the best event only for roughing.

GRAPHITE DUST

The graphite dust generated during wet milling was washed away by the cooling emulsion and then again cleaned out by GF through a specially appointed peripheral equipment. Enforced long-term tests have shown that this cycle is working correctly. The machine interior as well as all the conducts remain clean and free of debris despite graphite machining.

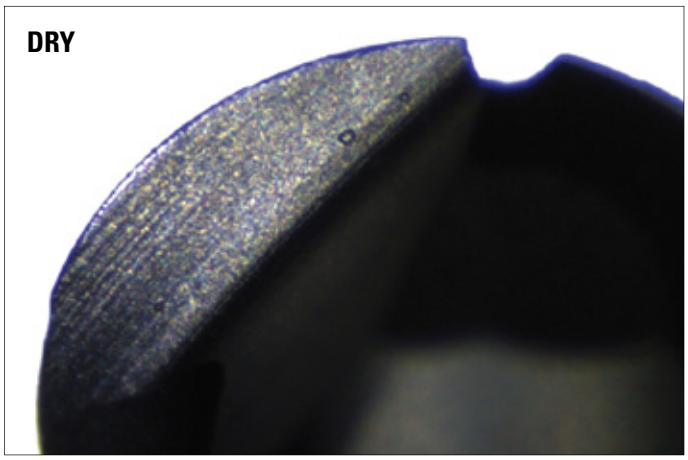
SPARK EROSION

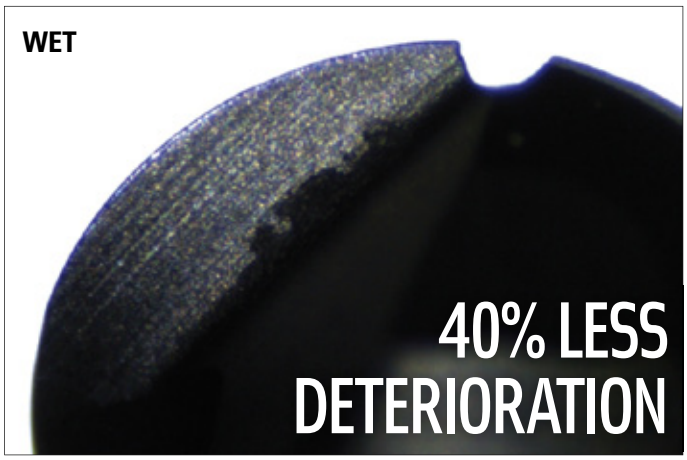
So much for the milling tests. Since I don't have any depth experience in dealing with the current spark erosion generator (EDM machine) from GF, I left the implementation of all spark erosion trials to the professionals of GF.

Spark erosion was done with the electrodes previously prepared in dry and wet emulsion

Respectively compared were the erosion time, the burn-off on the electrodes and the surface roughness on the finished component. The experiments were carried out several times, so that a possible variation could not have a negative impact on the result.

The spark erosion trials have brought a fairly similar result (picture and chart).





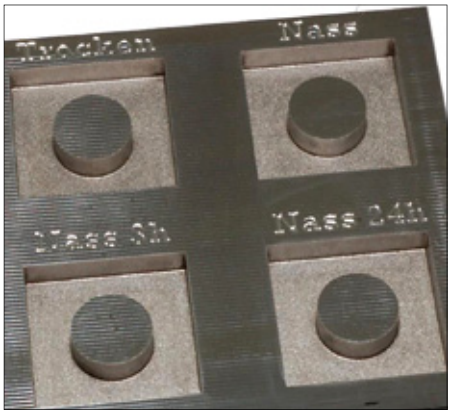
DRY MILLING, milling time 490 min.

type of cutter	measurement	deterioration
SEAGULL ball nose endmills	B-2-20-60	max. 0,0087

WET MILLING, milling time 490 min.

type of cutter	measurement	deterioration
SEAGULL ball nose endmills	B-2-20-60	max. 0,0052

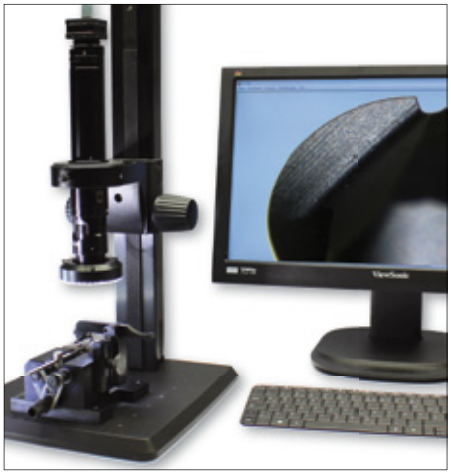
MEASUNRING EQUIPMENT: Diameter and concentricity with Z-Mike 1210 Laser measuring device, outline and surface with C-VIEW, optic 1000 times magnification



SPARK EROSION DATA

electrode	sparc erosion time	fringing
dry	00:39:58	5 µm Ra 0,82
wet cleaned with compressed air	00:41:20	3 µm Ra 0,84
wet after 3 h time to dry	00:41:58	5 µm Ra 0,87
wet after 24 h time to dry	00:42:03	6 µm Ra 0,86

In experimental setup were used each a roughing and finishing electrodes. The terms „dry" or „wet" refer to the method of production of the electrode.



C-VIEW was used to visually check both the cutter and all components.

CONCLUSION

All knowledge gained from the performed eroding and milling tests showed that graphite can be handled wet without any problems, also with electrodes that became wet can be eroded without problems and even discovered a number of advantages resulting over traditional dry machining.

One of these advantages is that you get a clean electrode of the milling machine, which certainly has a positive effect on all subsequent steps such as quality measuring and eroding. Especially when high accuracy is playing a major role when eroding. Incidentally, it is also good for the general cleanliness in the premises, because it is a fact that graphite is black.

I think the decisive advantage is however: whether working with steel, aluminum, copper or graphite from now on can all be done on the same machine. This circumstance will probably allow some mold and tool factories to switch to graphite and so to take advantage of the material itself.
I am convinced that all these circumstances will positively affect one way or another future business calculations.

Not to forget is the positive side effect of the significantly lower deterioration of the cutter because the operator can use this to his advantage. Well proven again is the short cutting edge geometry of SEAGULL. This was reflected not only in the graphite dry machining as a particular advantage over conventional cutters with long cutting edges, but especially in wet machining of graphite, was the SEAGULL cutter through his short cutting edge a class by itself!

All test results are at GF in Schorndorf and can be visited any time by appointment. Contact at GF is Mr. Benjamin Sendler: benjamin.sendler@georgfischer.com / Phone: +49 7181 926 451

Of course I am also a contact person and you can best reach me by email: daniel.gruber@cimtrode.com

The trial has brought a lot of new and interesting informations to me. I did not think that I would ever write about wet graphite processing in a positive practice report. But according to the motto: „You never stop learning", I hope that this report holds some suggestions for you to deal further with the issue and might be able to pull one or the other own benefit. I will report back to you again as soon as there is relevant news about the graphite-wet processing.

Daniel Gruber

You find SEAGULL tools at the companies CIMTRODE and ZECHA.