First on the market – fully controlled and “on-line” maintenance of the Pulse Plasma Compaction (PPC) system. High costs effectiveness through high energy efficiency and sintering repeatability in performance. PPC as the breakthrough method allows to create new materials and markets (e.g. Diamond Enhanced Cemented Carbide (DEC)).

www.genicore.pl
PPC (Pulse Plasma Compaction) is a universal and efficient way of powder consolidation. Its versatility provides a possibility to consolidate pure metal powders, metal alloys and ceramic and metal composites; especially in the production of super-hard composite materials based on diamond – DEC.

During the PPC process, electrical energy stored in the battery of capacitors is emitted in consolidated powder using electronic switch. The PPC is the leading technology, among others, of EPC methods, and is the only one which is applied in industrial scale because it solves the persistent problem of very poor durability of mechanical switches resulting in the erosion of the electrodes and the limited repetition rate of pulsed discharges.

The use of capacitors as the source of energy ensures specific heating and cooling conditions, with this specificity lying in that the energy of several kJ is delivered to the powder being sintered within an extremely short period of 0.2 ms. During the flow of current, the powder is heated to a high temperature and, after the current flow vanishes, it is cooled to the specified sintering temperature very rapidly.

The PPC technology of the GeniCore company relates to the device used for the consolidation of powders by high current (the order of several dozen kA) generated by discharging of the battery of capacitor and a high voltage pulses repeated at high frequency of several dozen Hz, which allows for fast and precise temperature control in the process of consolidation of powders.

An important element in PPC devices, determining their faultless functioning, is electronic switch used to discharge of the battery of capacitors. The PPC technology of the GeniCore company thanks to the replacement of mechanical switch (thyatron, ignitron, vacuum or air switch) by electronic switch provides final user with the following advantages:

- radical improvement of switch durability,
- repeatability of current pulses,
- higher switch operation frequency (out of reach for vacuum and air gap switches),
- lower maintenance cost (no replacements of worn-out electrodes).

The PPC devices are fully prepared for industrial purposes as well as for research work. They are equipped with systems of controlling the process parameters, which are collected by the central computer in the real time.

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Pulse Plasma Compaction

1. Vacuum - fast and effective vacuuming.
3. Energy - controlled power and time.

Sintering unit includes the following main modules:
- Vacuum Chamber with pumping system and press frame,
- Hydraulic Unit,
- HV Power Supply,
- HV Capacitor Bank,
- HV Electronic Key.

Vacuum Chamber

is equipped with vacuum - voltage glands together with electrically insulated slideable punches and electric terminals.

Control hardware of PPC devices consists of:
- PLC controller, in which the control algorithms for sintering machine are implemented,
- Touch screen HMI system, which enables current operation of the device,
- PC for preparing recipes,
- IP camera that records sintering process taking place inside the chamber and archiving the data on the PC.

User friendly software with an ergonomic workstation

Vacuum Chamber Specifications:

Chamber [mm] 550 x 555 x 500
Working pressure [mbar] - 5x10⁻⁶
Pressure [kN] 200
Temperature [°C] 0 - 2000
2-Axis Stroke [mm] 250
Maximum discharge voltage [kV] 6
Maximum current in a pulse [mA] 60
Period duration [ms] < 1

* Maximum temperature is limited by material composition, die & punch dimensions and holding time.
So far, tools based on diamond have undoubtedly revolutionized the tool industry by their significant increase in the efficiency of machining. One of the major challenges in this area is processing of materials using very high cutting parameters, with high quality of the machined surfaces. In this regard, ensuring a long life time of tools is very demanding.

However, it should be noted that the use of low-melting alloys as the matrix for diamond tools, such as copper alloys with the addition of iron, nickel that are characterized by a much lower hardness than the diamond, leads to the fact that the wear of the matrix occurs much faster leading to the loss of diamond particles. Moreover, their properties are utilized only to some extent.

In order to achieve the desired cutting performance for diamond tools, special attention should be paid to the requirements set in terms of the matrix. Excessive wear level of the matrix shall lead to prematurely pulling the diamond particles, while too low wear leads to rounded sharp edges of the diamond. In addition, the matrix has to be characterized by high strength at high temperatures and resistance to dynamic load in order to withstand the high temperature and vibration occurring in the cutting process.

A new group of sintered tools for processing of construction materials are super-hard composite materials based on diamond and cemented carbide matrix. The high hardness of the matrix made of cemented carbide can improve the resistance to abrasive wear of these tools and the strong bonding of diamond particles with the matrix.

Specific features appearing during the PPC process allow to fabricate a new, created by GeniCore, DEC material. It can be produced during the thermodynamic instability of the diamond, which is what renders this process technologically competitive, when compared with traditional sintering methods (which prohibit diamond sintering due to the graphitization process), and financially competitive, when confronted with HPHT technology of diamond sintering.