6th International Conference on Shaping of Advanced Ceramics

Shaping VI

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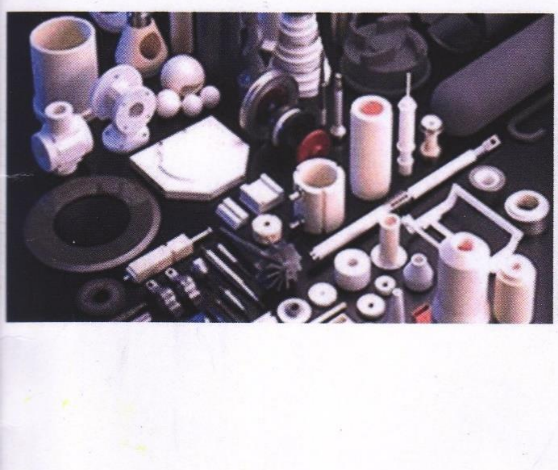


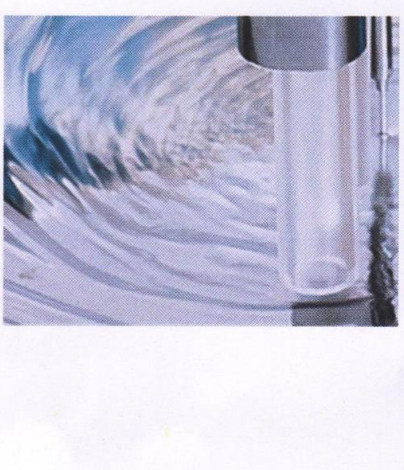

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Compaction of Ceramic Powders Using Pulsed Electromagnetic Field

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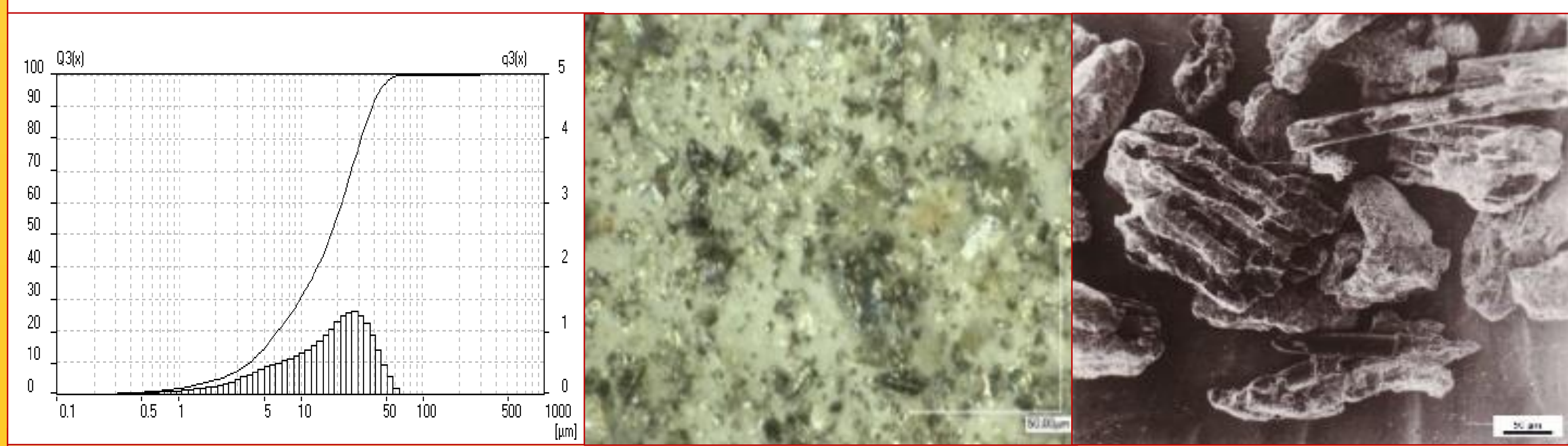
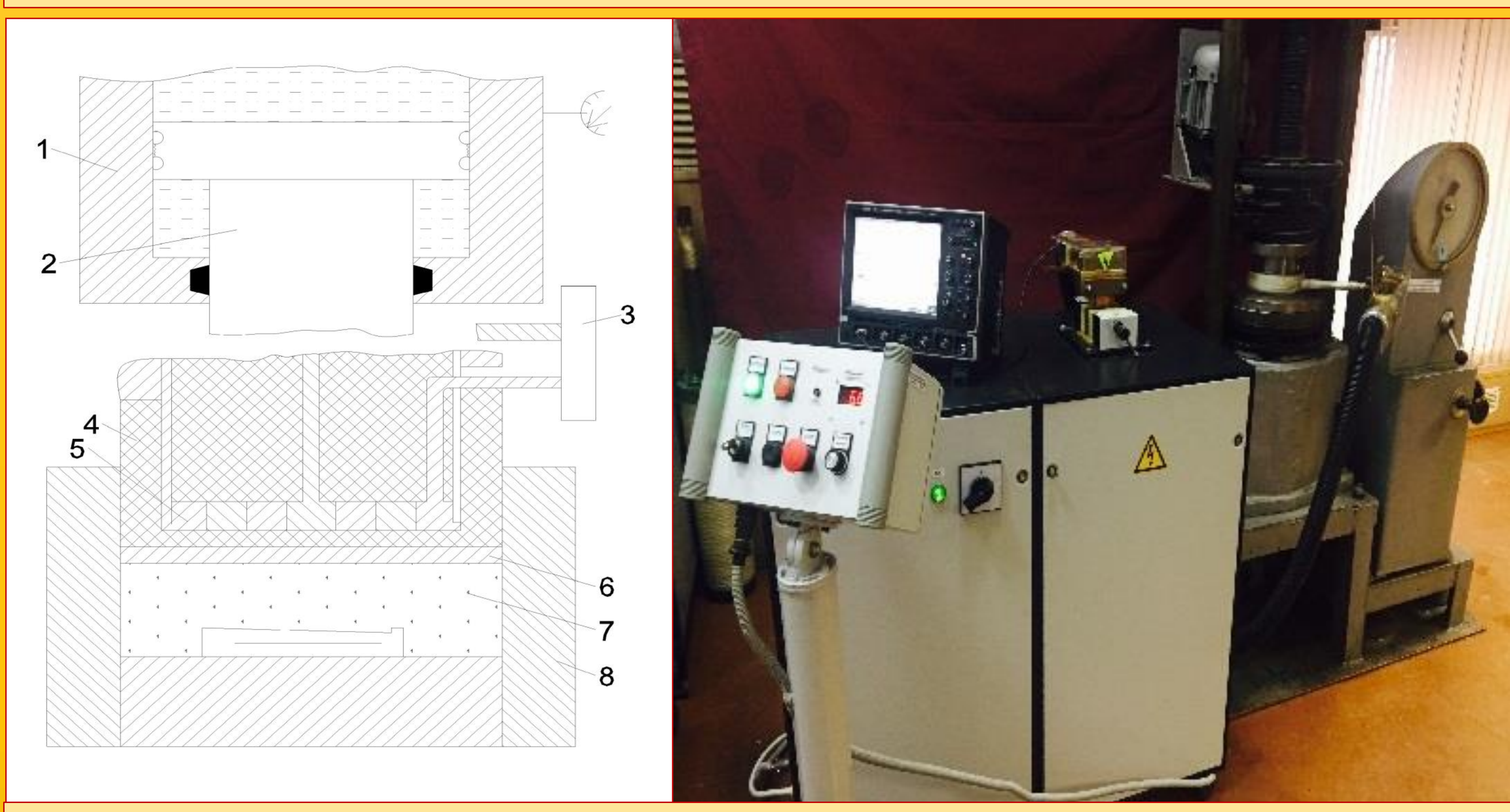
Introduction. Compaction of ceramic materials is an important technological operation. From the variety of existing methods of formation is necessary to assign static and isostatic pressing, in which the compact is applied to the constant pressure to provide the desired density prevalence of the volume of the material. To increase the density also dynamic compression techniques are used, especially using a electromagnetic pulsed field. Compaction powder composition is carried out by crimping it in the rigid matrix, or a deformable metal shell [1]. However, this method does not allow to achieve uniformity and high density properties. Therefore combined methods combining static and pulsed magnetic impulse compaction are attractive. The process for compacting powdered material prior static compaction step in this case can be considered as the process of particle glide relative to each other and the deformation of particle contact parts. With the increasing compaction of the pressure, the density of the agglomerates increases due to the better packing of the particles and increased their contact surface. Impulse loading allows to improve these processes. When there is a compaction in a rigid matrix processes static and pulse loading it is advisable to alternate with a gradual pressure increase.

Experimental studies. Materials and methods.

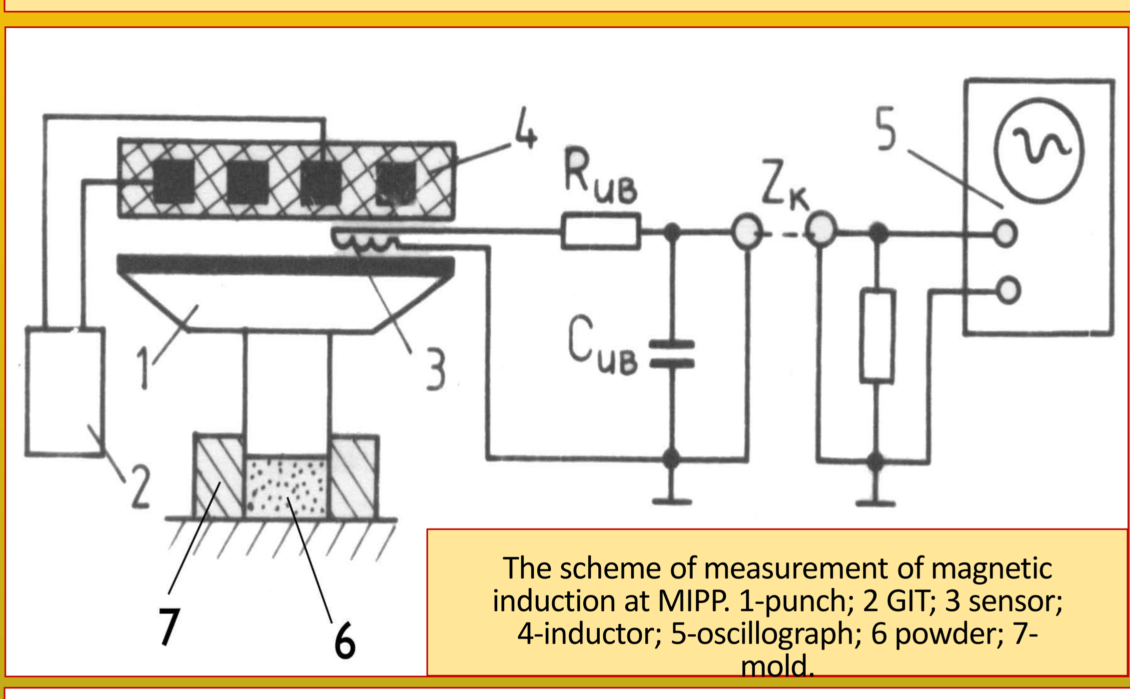
Experimental studies were carried out mainly on the powders of materials SiC; SiC-Si; Al-W-B technological waste, obtained by grinding using the disintegrator.



Particle size distribution (a) and morphology SiC (b), Al-W-B (c) of ground product after final separative milling by laboratory disintegrator system DSL-175



Scheme (a) and part of the equipment CMD-1 (b) for the CMPC of the ceramic powder. 1–Compaction form with powder; 2–hydraulic press; 3–pulse current generator; 4–housing; 5–flat coil; 6–plate with electrically conductive coating.



The scheme of measurement of magnetic induction at MIPP. 1-punch; 2 GIT; 3 sensor; 4-inductor; 5-oscillograph; 6 powder; 7-mold.

The magnetic pressure is estimated from the measured magnetic induction in the gap between the shock plate and the inductor by the method described in [2]. To control the movement of the punch at MPCC, a measurement scheme with an optical lattice was used.

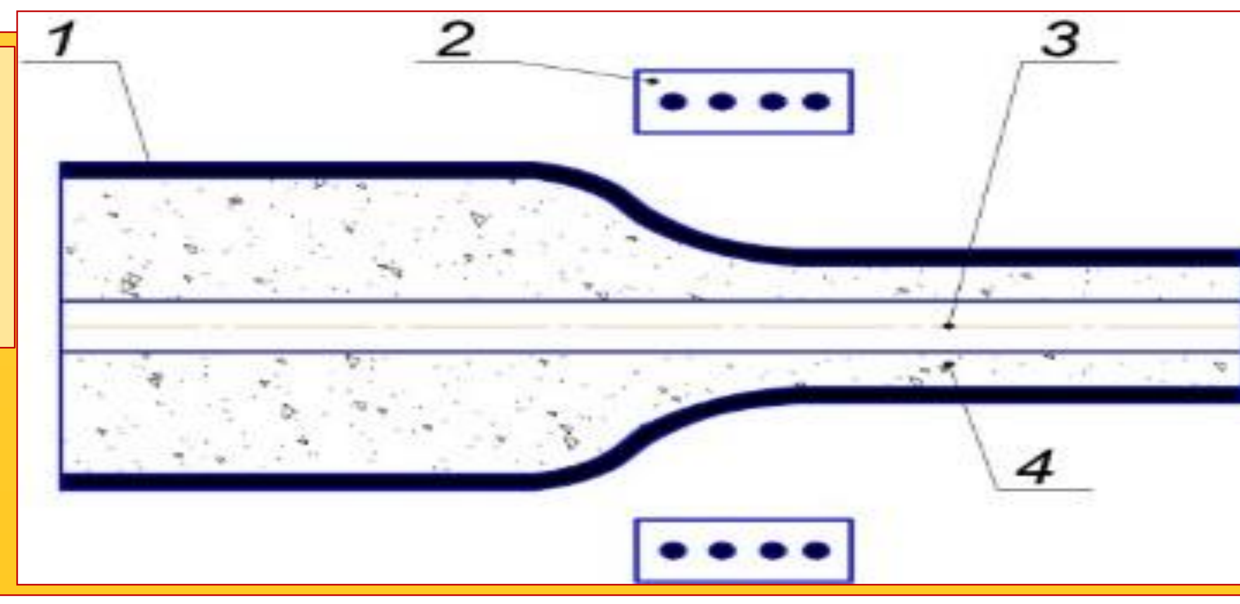
Main technical characteristics of the experimental complex CMD-1

Hydraulic press D2430B	Pressing force of 0.1–10 kN	Specific pressure 50–100 MPa	Speed 0.004 m/s	Stroke 150 mm
Magnetic impulse installation IG 18/5	The stored energy 1–18 kJ	The amplitude of the electro-magnetic pressure 250 MPa	Speed of movement of punch 0.1–10 m / s	Counts per minute 1–5
Compaction form	The outer diameter of plate 180 mm	Diameter of the punch 20 mm	Volume of the filling chamber 236 cm^3	The mass of shock plate 6.8– 24.0 kg
Inductor	Diameter 150 mm	Number of turns 16	Operating voltage on the inductor 0.5– 5.0 kV	Guaranteed number of discharges before the destruction 600

Scheme of Magnetic Pulse Compaction

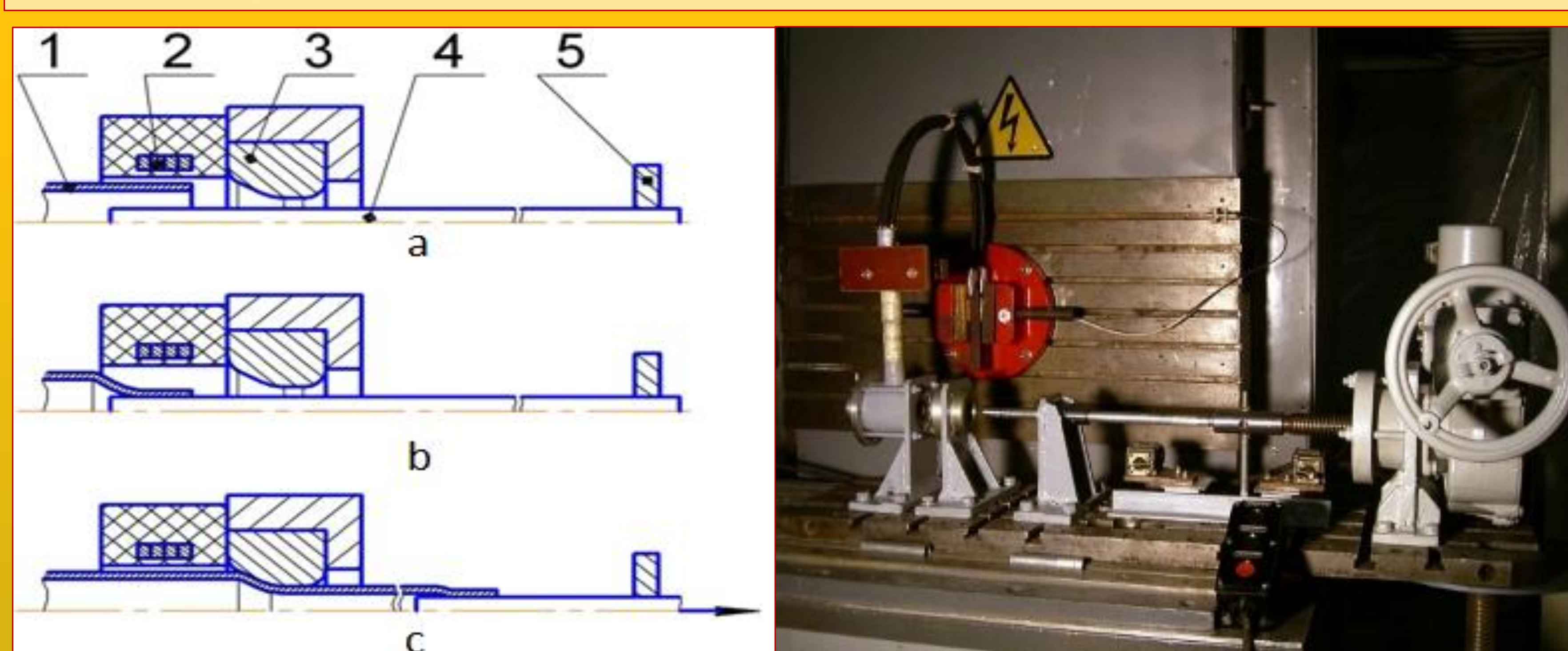
For the extended objects it is advisable to use step-by-step compaction of a thin-walled shell powder. The powder mixture was placed in a thin-walled metal shell (copper, steel, aluminum).

Scheme of the step by step MPC of powder for the manufacture of tubular products. 1–electrically conductive tube-shell; 2–coil; 3–mandrel for forming the internal cavity; 4–powder.

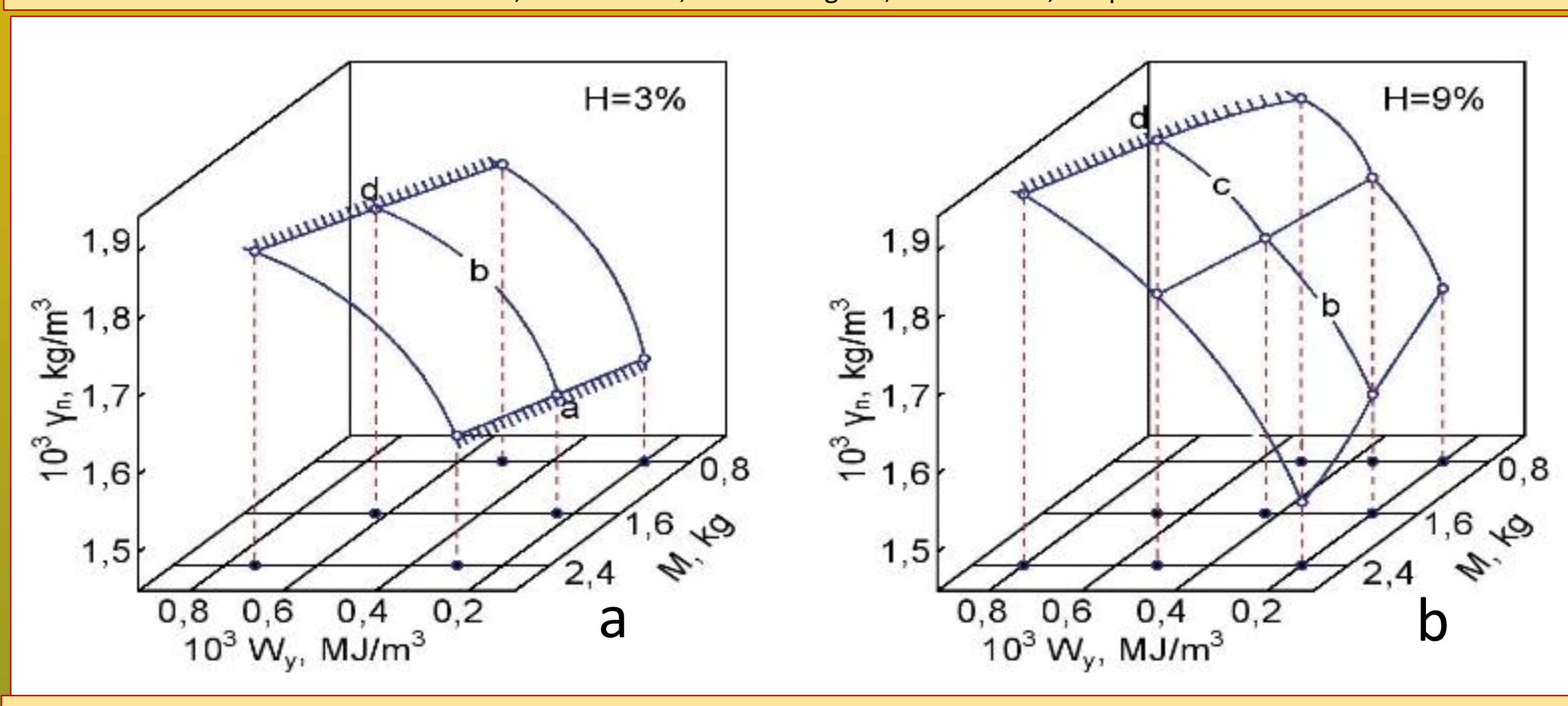


The PC generators with frequency range 10- 50 kHz and energy storage from 1 to 20 kJ.

Flat-coil, cylindrical coil and form for the CCPM.



Scheme of compaction (a – starting state; b – stage of press-forging; c – stage of drawing).
1 – billet; 2 – inductor; 3 – drawing die; 4 – mandrel; 5 – puller



Influence of specific energy MPCC Wy and the mass of the shock plate M at a density of compacts at humidity (H) of the charge 3% (a) and 9% (b).

Summary

1. It is shown that the combined magnetic pulse compaction method can be successfully used for obtaining ceramic products from clay-containing materials.
2. During the impulse loading, the mass of mobile elements has a significant effect on the final density of the product.
3. It is revealed that compositions with small water content (6–8%) are the most effective for producing ceramic by CMPC.
4. The CMPC method allows obtaining more quality materials with uniform density and less shrinkage during process of sintering.

References

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