Conference Paper

Electropulse Compaction of Metal Shavings and Waste Products

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Abstract

A promising way to develop efficient technologies for obtaining materials with a new level of properties is the use of high-intensity energy flows as a technological tool, incl. electric current. Electropulse compaction (briquetting) of metal waste ensures their rational processing and obtaining cheap porous materials and products. As a technological tool, an electric current of high density is used.

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1. INTRODUCTION

The sustainability strategy of the world economy in the context of limited resources assumes the development of the effective technologies of receiving materials and semi-finished products with the new level of properties, including waste products [1]. A perspective way of their creation – use as technology tools of flows of energy of big intensity, including electric current [2 - 4]. Electropulse compaction (briquetting) of metal shavings, boring or chips provides their more rational processing (remelting) in the form of briquettes and receiving cheap porous materials and products [5 - 11]. As the technology tool electric current of big density is used (Fig. 1.).

The crushed waste presses with rather small pressure, and then subjects to processing with use of short impulses of electric current. This processing allows to connect the pressed material in a strong briquette. All metal when briquetting heats up slightly, and local zones of contacts for a short time, it, allows to avoid essential oxidation of metal even when briquetting on air of such chemically active metal as titanium [5, 6]. For forming of a briquette local short-term impact on initial raw materials of a flow of energy of big density - an impulse of electric current is used. The locality of influence is provided with a method of influence, and durability of material forms due to pulse electric welding of contacts between metal particles. In a zone of contact of particles there is a melting, contact surfaces approach, liquid metal keeps and spreads in a contact zone, creating a welding point [13, 14].

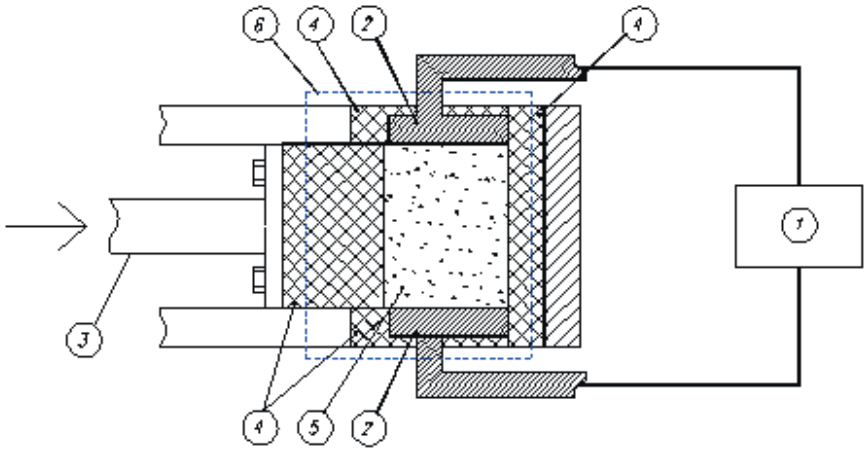

Figure 1: The scheme of process of electropulse briquetting for option at which electric current is passed perpendicular to the direction of pressing. 1 – A source of pulse electric current, 2 – electrodes, 3 – the press piston, 4 - insulators, 5 – shaving, 6 – the electroisolated compression mold.

2. EXPERIMENTAL PROCEDURE AND RESULTS

On laboratory, trial and model installations (fig. 2. photo of a trial briquette of fig. 3.) briquettes of a different form, the size and density are made of shaving of titanic alloys of different grades, including high-strength, (VT1-0, 3M, VT20, Ti-10V-2Fe-3Al and др) briquettes from shaving of the majority of other metals: copper, brass, aluminum, cast iron and steel (including non-magnetic corrosion-proof, carbonaceous, alloyed); the crushed steel scrap, a metal cord [5 - 12].

Mechanical tests of briquettes of different density showed: with a small amplitude of the passed current briquettes are not formed, at her increase briquettes of small durability are formed, then durability of briquettes begins to grow. At rather small contribution of energy (~ 5 kw hour/t) durability of briquettes on a gap exceeded 200 kN/sq.m that it is enough for their transportation and processing. The best sample from among those which we could destroy by our technique had durability on a gap ~ 500 kPa, stronger samples slipped out hijacking of the explosive car. Influence of process of briquetting on quality of the received metal was investigated, it is established that metal pollution by oxygen and nitrogen [5], including in a zone of points of welding [6], does not interfere with their use. Temperature of briquettes after processing does not exceed 200 °C. At such heating there is no gas-saturation threw, besides, it shows that the technology is energy saving.

It is offered to use briquettes for alloying of metals [7], including: made of metal shaving – ligatures, mixes of shaving of different metals, composite briquettes from shaving and the lumpy material as which is carrying out and dielectric, in particular elimination of small fraction of ligatures of usual type. Briquettes with dielectric and

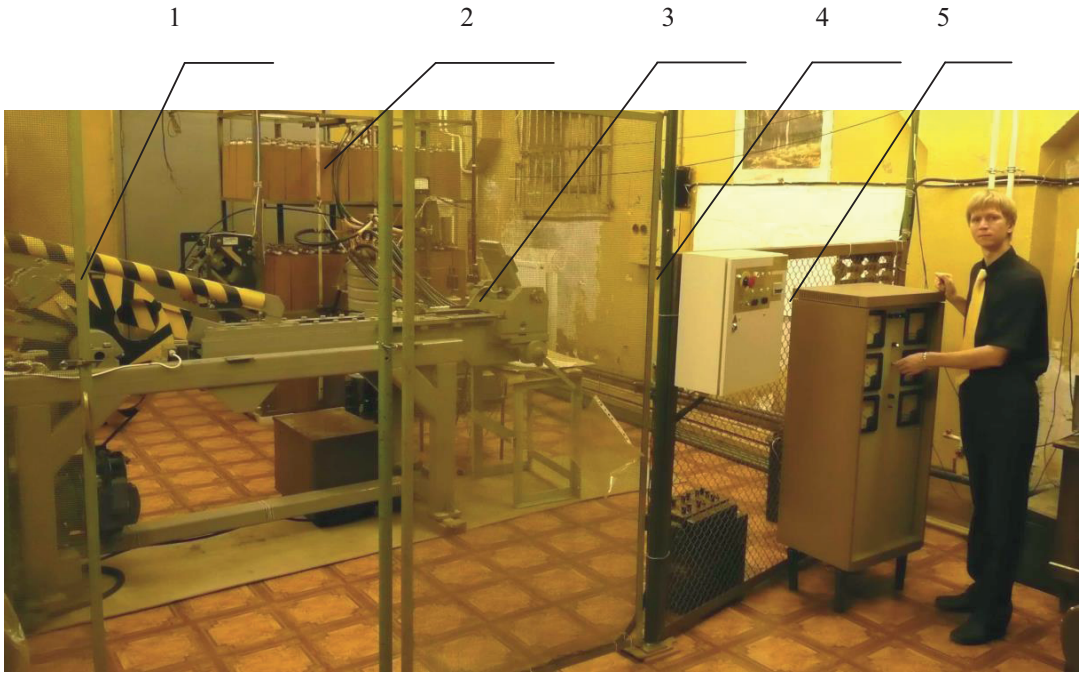

Figure 2: A model model of installation for briquetting of metal shaving. 1 - a press, 2 – the condenser battery, 3 – the pressing camera, 4 – the control panel a press, 5 - the control panel the condenser battery.

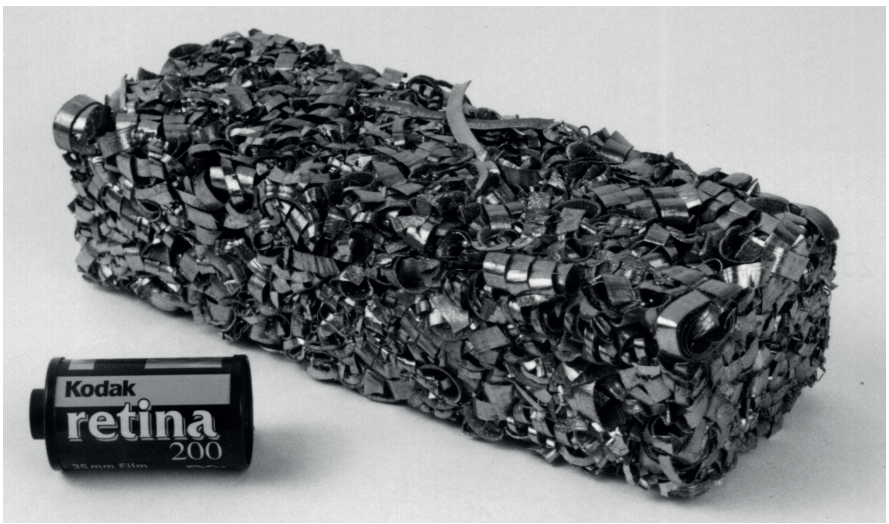

Figure 3: Photo of a trial briquette. Shavings of titanic alloy 3M. Briquette size: 175x64x50 mm; density is 1,1 g/cm^3 (porosity of 75%); mass of 590 g.

electroconductive inclusions are received, and the conductivity of inclusions both is slightly higher, and is significantly lower, than at a basis. Concentration of a lumpy phase can make to a half of amount of a sample. This process is important for receiving ligatures of new type and return in metallurgical process of many types of the disperse waste which is formed in metallurgy and metal working, in particular iron scale [8], it can be used for receiving composite materials. The possibility of microalloying and

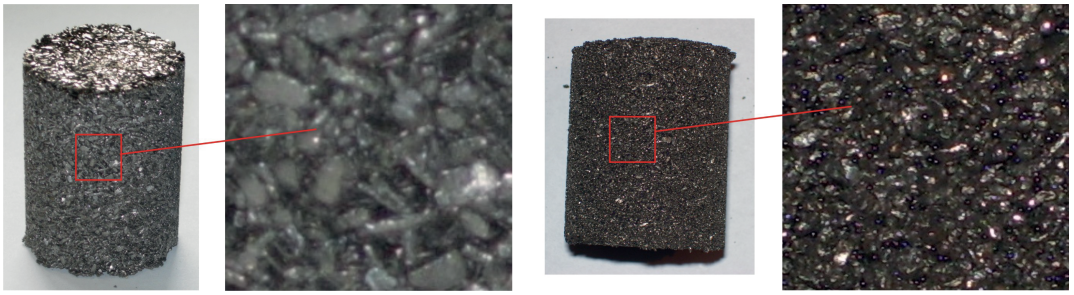

Figure 4: a) A briquette from titanium powder. Size: diameter 35, height is 46,5 mm; the mass of 103 g, density is 2,3 g/cm^3; porosity of 50%, talus of powder of 2,5 g, 2,4%; b) the enlarged image of the central part of 1x1 cm in) the Composite briquette from powder of titanium and vitreous mineral balls. Size: diameter 35, height is 40,5 mm; the mass of 109 g, density is 2,8 g/cm3; a talus of powder of 3,4 g, 3,1%, the maintenance of balls on the bulk amount of 20%, on the weight of 16%, in volume of a briquette glass of 9%, titanium of 55%, a time of 36%; d) the enlarged image of the central part of 1x1 cm, brilliant lilac balls are visible.

refinement of aluminum alloys with use of briquettes from shaving of titanic alloy, alloying staly the briquettes made of mix of 30% of steel and 70% of titanic shaving (an analog of 70% of ferrotitanium), alloying of titanic alloys composite briquettes from titanic shaving containing pieces of aluminum and an alyumovanadiya is experimentally investigated.

It is offered to use briquettes from aluminum alloys as a cartridge for a hydrogen production [9].

Together with OOO "Novye tekhnologii engineering" the effective method of receiving metal powders is developed by shaving grind, trial briquettes from powder, and briquettes with inclusions from glass balls (fig. 4) are received., their content was 20 and 30% on bulk amount [10].

The electroplastic technology of briquetting provides the high performance of the process and doesn't take a lot of energy. The production of briquettes is economically justified because of their higher cost. It is reasonable to use metal briquettes as semi-finished products, materials and products.

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