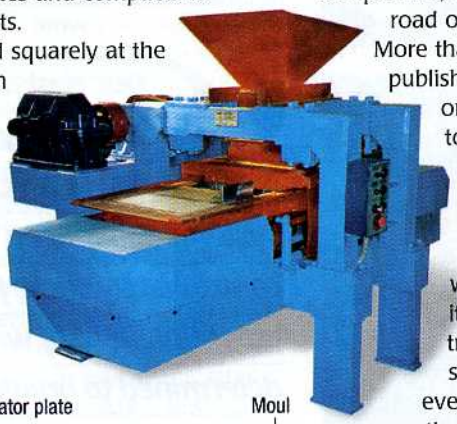
A knead for greater strength

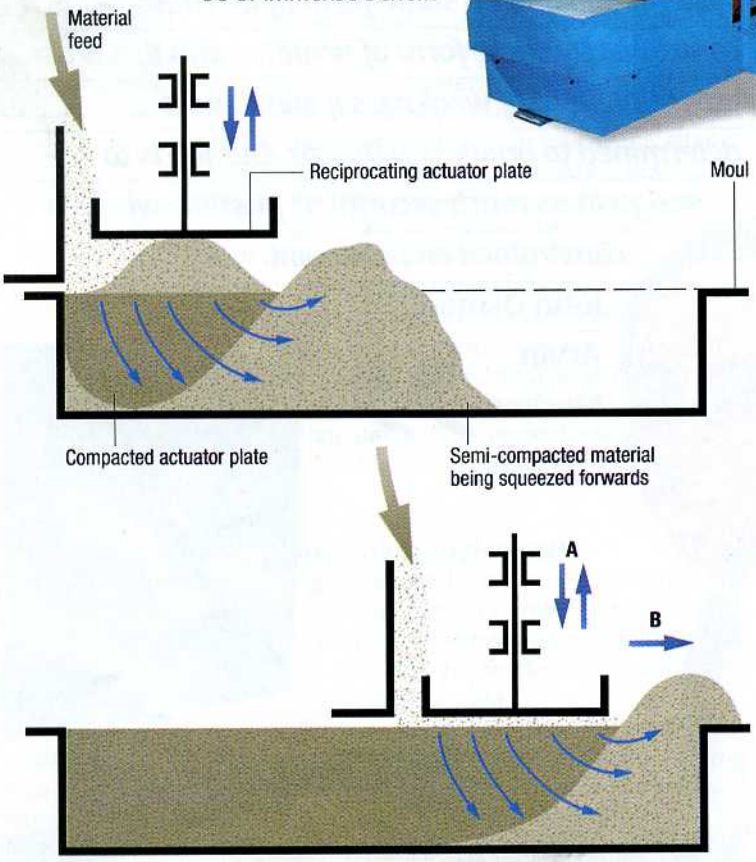
A simple technique is expected to have a revolutionary effect on making products from cements to concretes, and even affects food processing. Tom Shelley reports

A small Russian company has come up with a simple way of achieving maximum strength on concrete blocks, cement fabrications and powder compacts, which also improves some food processing operations.

Using a kneading action as opposed to vibration, it elegantly solves a problem that has been bugging engineers for decades, namely, how to easily obtain maximum density in pastes and compacts to be made into solid objects.

Although it is targeted squarely at the building and construction industries, its ability to produce stronger objects from powders and pastes is likely to be of immense benefit in the production of engineering ceramic parts by lower cost routes as well as other industries.



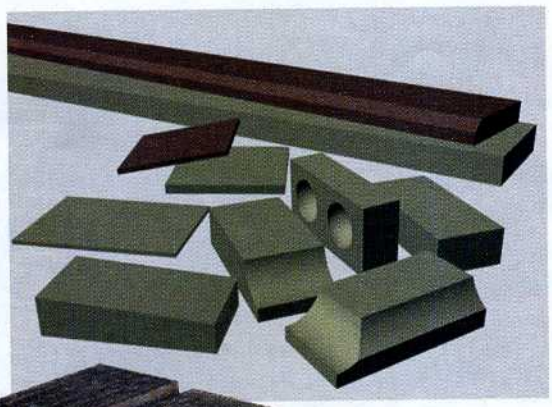


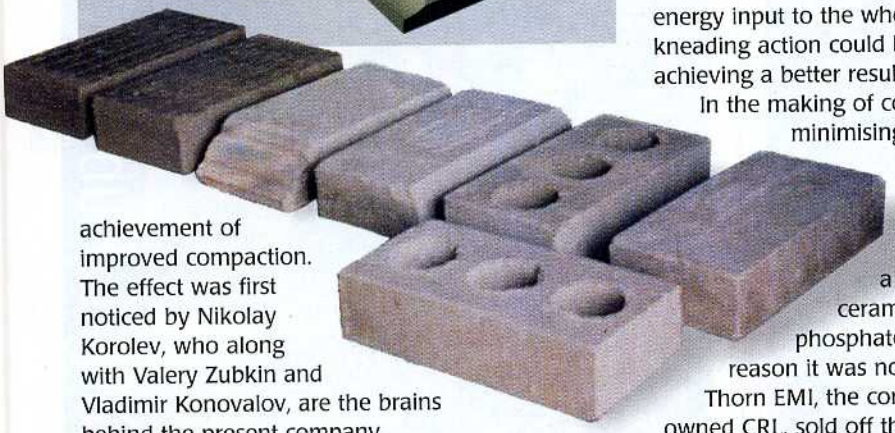
Every materials engineer knows that the key to the successful manufacture of ceramic moulds or components is to achieve maximum 'green' density, and get as much of the air out as possible. Countless research investigations have shown that strength and durability is increased by initial compaction, whether the final product is an asphalt road or a ceramic component for aerospace. More than two decades ago, ICI researchers published details of a technique by which ordinary Portland cement could be used to make sheets of very high strength material, by carefully rolling cement paste onto glass sheets in order to eliminate the smallest voids. If anything ever came of this research, we at *Eureka* would like to hear about it, but we suspect that following the traditional path of British innovation, a scientific paper was published, everyone said how clever it was, and it was then forgotten when the researchers moved on elsewhere.

Compression not vibration

In normal, conventional operations, if an initial mix is made from wet powders, or a suspension in water, the usual approach is to vibrate it to release as much air as possible. The water itself is not a problem because it is usually taken up in the crystal structure of whatever is being made. In asphalt road making, engineers often employ heavy rollers with vibrating drums, the amount of force applied only limited by that which might break the stones in the mix.

The 'Russkiye Kachely' or Russian Swing on the other hand, depends on a vertically reciprocating actuator. Material is introduced into the mould beside the actuator, starting at one end of the mould. On each upward stroke of the actuator, a new portion of material is introduced. On each downward stroke, the actuator compresses the material, and at the same time causes surplus to flow out beyond its edge. It is this combination of compression and flowing which results in the





achievement of improved compaction. The effect was first noticed by Nikolay Korolev, who along with Valery Zubkin and Vladimir Konovalov, are the brains behind the present company.

Once material starts to be pushed out, the actuator and feeding arrangement moves along the mould in the direction of the pressed out material.

The company currently produces small desktop-sized and larger industrial sized machines. The desktop machine, designated MN 05, can be powered by an electric hand drill rated at 600W or more. Fully assembled, it measures 1040 x 386 x 712mm and weighs 52kg. It produces moulded material 250mm wide, and 20 to 66mm thick. Production speed is 300 to 500mm/minute. Despite being a hand tool, tests by the Russian Building Materials and Construction Production test centre, TSNIIS-TEST show that items moulded from a fine concrete mixture had densities not less than 2,300 kg/m^3 , a compression strength of 45 MPa and bend strengths starting at 10 MPa. They also exhibited good water and frost resistance, a matter of some importance in a cold climate!

A larger RK 250 machine produces 250 blocks per hour, each 390 x 190 x 90mm. The motor is rated at 6.2kW, although power consumption is normally less than 4kW. It measures 2210 x 1820 x 1580mm and weighs 1700kg.

The team claims that the machines can handle a range of materials that include: soil, rubble, sand, concrete, asphalt, sawdust, coal and mineral ore fines, ceramic refractory, metal powders and sunflower seeds.

The machine would appear to be an ideal adjunct to asphalt and concrete road paving machines. Asphalt road pavers make considerable efforts to apply some compaction to the asphalt mat they lay down, before the road rollers get to work on it and push the material around. At present, the paving screens use tampers and vibrators that use a significant amount of the energy input to the whole machine. An enhanced kneading action could be of great usefulness, achieving a better result with less input of energy.

In the making of components from concrete, minimising porosity is crucial. Developments reported in *Eureka* in the past have included the development by Hayes-based firm CRL of a method of casting of ceramic cooker tops from a special phosphate-based concrete. The main reason it was not taken further was that Thorn EMI, the company which at that time owned CRL, sold off the company making the cookers. However, it was established that remarkable engineering components could be made from concretes under the right conditions.

Further, the Russian swing technique is not totally dissimilar to the traditional methods used in the hand preparation of sand casting, which involves ramming with a wooden tool to compact material beneath it as well as pushing material to each side.

In mining and mineral processing, there is a requirement to improve the briquetting of ores and coal fines.

In a totally different industry, the technique shows promise for producing juices and oils, applying a technique not dissimilar to a baker kneading dough or the treading of grapes to produce wine. The developers also see applications in the grinding, mixing and compression of friable materials in various other branches of industry.

The invention is protected by 11 patent applications and won the gold and silver medals at the last Moscow International Fair of Innovations and Investments. The firm is based in Moscow.

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- Technique achieves improved compaction and minimal porosity in ceramics and concrete by applying a kneading action to the initial powder or paste
- The technique is said to be much more effective than vibration
- Minimal energy is required
- The technique may also be applied to food processing

"Eureka says..."

A simple piece of mechanics turns mundane products such as Portland cement concrete into reasonably high strength engineering materials, as well as improving the compaction of powders and providing a new way to extract oils and juices in food processing

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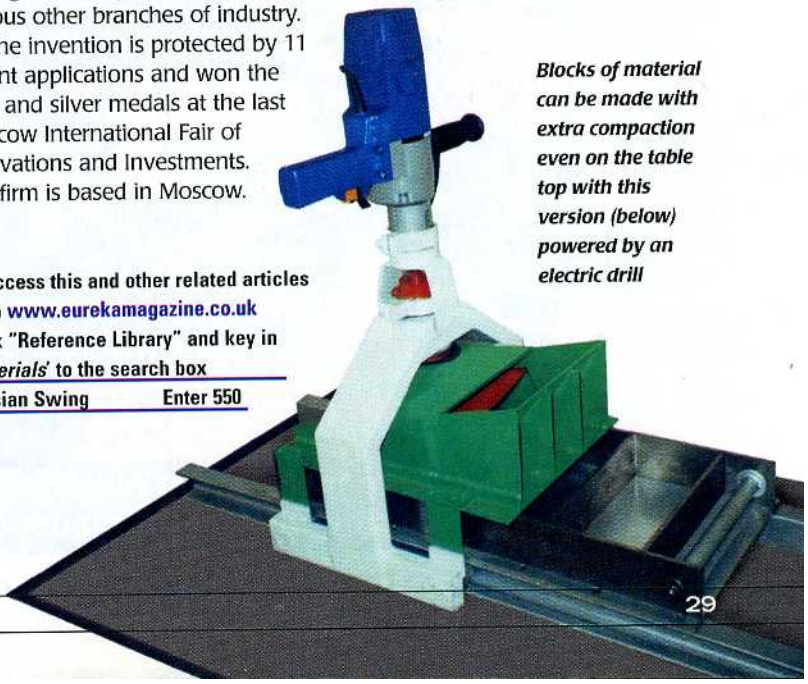
Russian Swing Enter 550



Blocks of material can be made with extra compaction even on the table top with this version (below) powered by an electric drill