

Technology Update

Drop by drop Principle of Manufacturing Machine Tools

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3D Printing: With the “Liquid Metal Printing”, the machine tools manufacturer Grob gets into world of additive manufacture (production). The Bayern promise precise construction components in shorter time.

That is just doubly remarkable. One undertaking, worldwide known for its shaping machine tools, gets into the 3-D printing and sets up with that on an almost unknown technology. The creation is of Grob Group from Mindelheim. It has a development machine “Liquid Metal Printing” (LMP).

How it came to this unusual possibilities. Johannes Glasschröder, team manager for additional production knows “The automobile industry in which our machines are very much set up undergoes precisely massive change. However we have searched for additional business capacity.” Along with that we have with many potential also uptodate users of additive production spoken result “The users of widely circulated powder-bed technologies complained regularly of the complicated powder-handling the low reconstruction rate and be the necessary voltage poor red hot condition. It is true the surface and edges of construction parts are good but that plays, however with many users no big role.

One who manufactures on the contrary component parts, as per instruction using welding was dissatisfied as our market study revealed the faulty precision (accuracy) and the very big maintenance cost.” Big surface metal must be always again removed. “From this we have

inferred that the “Liquid Metal Printing” is the right technology for us” as said by Glasschröder.

The principle of LMP is clarified by the graduate Mechanical Engineer as such “with the help of a pressure knob we generate in ‘drop on demand’ principle fluid aluminium drops.” These fall upon an x/y cross table which through the medium of spherical spindle power is dealt with constructions in the Z axis were possible through the lifting up of push button.

The plant the so-called GMP300 is extremely massive constructed. The cross-table must including heating and exposed structural parts - can be moved vigorously without causing vibrations. The stimulated structural chamber measures 300mm x 300mm x 300 mm.

The material previously aluminium-silicon alloys, aluminium copper alloys and pure aluminium, one on a conveyor system led to push button.

At its foot there is a crucible resisting temperature upto 800°C. Optical sensor regulates the material supply so that the crucible fitting condition is always sufficient.

The drop output is a piezoelectric element controlled whose expansion accelerates a piston within the foundry. With that a pressure impulse is generated which pushes the fluid metal through the nozzle.

“The drop size is strongly variable” says Glasschröder. It is dependent on nozzle diameter as also the acceleration and amplitude of piston.

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A nozzle with a borehole measure of 300µm allows the drop output, which finally measures 280µm. With bigger nozzle we have produced also drops of 1 mm diameter.

The variation of dropsize and with that the output quantity is possible for the machine tool change system.

The output frequency is noteworthy. 500 drops per second are possible without any problem. "We have also already with 1000 drops experimented. However, the frequency is not all decisive, the expert knows that.

The construction rate can be visible:

With 500Hz and drops with diameter of 700µm we make by computation analytically 320 cm³/hour. If the drop-size is set at 800µm, it is already over 480 cm³/hour. As comparison: powder-led machine with four lasers would make nearly 130 cm³/hour. Plants as instructed by welding operation about from 500 cm³/hour upto 600 cm³/hour.

Also with the solution the LMP of Grob between both alternatives is the printing method. Glasschröder advises the layer height always comes upto 65% of dropdiameter. With a 500µm nozzle that is however 327µm. The minimum wall thickness lies about 0.5mm.

The surface texture of structural parts is adjustable at the construction surface temperature as also output frequency, Glasschröder says. With relatively colder surrounding taking off shorter frequency the individual drops remain visible. With higher temperature and higher frequency on

the other hand the adjacent drops fuse with one another and with deep-scaled grooves (machine tools) corresponding smooth (plain) is then the surface. The optimal counterbalance of drop frequency structural space and structural parts temperature demand some experience. Thanks structural space heating the individual drops solidify relatively slowly. Result is a homogenous texture layer in structural part. Accordingly we have no low voltage incandescence necessity says the engineer. With expansion limits and ductile yield we place rather the parts above the limiting values of output materials.

In spite of drops output the LMP method allows the manufacture of overhanging. At present we are limited to 35 trademarks. Our objective is to reach at the 45 trademark. Beyond that with supporting structure must be recovered. To their production "we pile up individual drops" says Glasschröder. The result finished structural parts get easily separated.

How much the fun costs? For the machine the listed price is 450000€ including software. For service it requires as per statement of Grob-Mannes one technical skilled hand that must undergo training for the job for 14 days.

With a blink in future the expert dreams in the twinkling of eye of tanks which transport fluid materials in the factory in which the materials are directly processed. Automization is our aim.

Source: VDI nachrichten 3, Juni 2022, Nr 11, Technik & Wirtschaft, Seite 23, Tröpfchenweise zum Metallteil, Von Stefan Asche.
