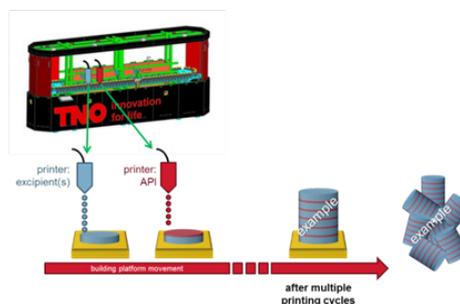


# 3D PRINTING OF ORAL DOSAGE FORMS



The TNO PrintValley 3D printing setup: a new approach to rapid 3D printing, employing a carousel type-arrangement of building platforms passing underneath multiple printing heads in order to significantly speed up production. The setup can print several dozens of ODF size objects per second. This approach may be used for pharma as well in order to reach relevant production volumes.



## TNO innovation for life

Imagine a future in which medication is produced that is matched exactly to your individual needs; a single tablet containing multiple APIs, all dosed to your body type, and all released at different locations in the GI tract. That tablet will be 3D printed.

### 3D PRINTING

3D printing is an innovative manufacturing process whereby an object is built up layer by layer from a 3D computer design. A variety of printing technologies can be used, which were developed for the manufacturing industry and hence typically process plastics, ceramics, and metals. 3D printing is used for the production of objects made from both single materials as well as combinations of materials, in which each materials may be deposited by a separate print head or other deposition step. Over the last couple of years TNO has been investigating printing technologies for their applicability in new areas and as a result TNO has become world leading in the area of 3D food printing. The success in 3D printing complete food products from a wide range of base ingredients and the realization that many of these ingredients are identical to, or share great similarities with, pharmaceutical ingredients

(excipients) has lead to an expansion of TNO's activities to the area of pharma. As all main 3D printing technologies (FDM, SLS, PBP, IJP, SLA) are available within TNO, a wide range of printing research is possible.

Much of the current research in pharma, apart from the API-related research, is aimed at (incremental) improvements of existing technologies or replacement of individual steps or technologies in the production chain. On a much more ambitious level some research is being carried out on the development of technology that might replace much larger parts (i.e. multiple steps) or even the complete Oral Dosage Form (ODF) production process. 3D printing of ODFs is one such technology!

### PRINTING ODFs

3D Printing of ODFs offers enormous freedom of design with respect to factors such as API dosage, API distribution within an ODF, excipient use and distribution, as well as tablet structure and shape. 3D printing can be used to create unique new products that other methods cannot emulate.

The potential uses of the technology are many:

- Easy fabrication of ODFs with varying dosages.
- Fabrication of ODFs with specific, designed release profiles.
- Easy fabrication of ODFs containing multiple APIs.
- Fabrication of ODFs with designed internal structure (e.g. microchannels).
- Fabrication of unique ODF shapes (marketing, anti-counterfeiting).

Such benefits can lead to interesting new possibilities such as different dosage regimes, new or better controlled release profiles, (truly) personalized medicine, better patient compliance, and many other.

### MULTIDISCIPLINARY APPROACH

Aside from the knowledge on 3D printing technologies other knowledge is also essential to move this technology forward. Mechatronics and ICT, specific pharmaceutical knowledge in the areas of materials, formulations and their behavior under various process conditions are just a few examples. By combining and merging these different disciplines TNO is able to offer unique, innovative and sustainable solutions in this field.



3D printed tablets (round, oval, and donut) produced by means of powder bed printing. (TNO)



### THE FUTURE

At this point in time the possibilities of this emerging technology are being explored with respect to the types of products that can be made from a materials and technology point of view and, derived from that, which functionalities can be realized. Additionally, within TNO 3D printing concepts capable of producing industrially relevant numbers of printed objects are being developed (see caption on front page). In brief, the potential is clear. However, to realize the prospects offered by the 3D printing of ODFs, research has to be continued. We are looking for business partners in the pharmaceutical sector, ranging from ingredient/excipient producers and pharmaceutical companies to equipment manufacturers (3D printing or other). Join us now to explore the possibilities.

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### TNO

TNO is an independent research organization with broad knowledge of several fields. TNO initiates technological and societal innovation for healthy living and a dynamic society.

### TNO

De Rondon 1, 5612 AP Eindhoven  
Utrechtseweg 48, 3704 HE Zeist  
The Netherlands

### CONTACT

Europe:  
Mr. Steven Erpelinck BSc MBA  
P: +31 (0) 6 23 29 56 37  
E: [steven.erpelinck@tno.nl](mailto:steven.erpelinck@tno.nl)

Japan:  
Mr. Kazuhiro Ariga  
P: +81 90 3965 9188  
E: [ariga@tno-pharma.com](mailto:ariga@tno-pharma.com)