

# Case study: printing powders with Sticky Web technology

## **The brief:**

GlaxoSmithKline (GSK) appointed 42 Technology (42T) to evaluate existing powder dispensing approaches that could be scaled for high-speed manufacturing.

42T suggested an innovative precision powder dispensing technology, now known as Sticky Web, which can accurately 'print' powdered APIs onto edible or inert adhesive surfaces to create a novel dosage form.

GSK has now granted 42T worldwide pharmaceutical rights to the technology.

**Howard Biddle**  
42 Technology (UK)

Powder handling is technically challenging at the best of times, but accurately filling capsules with milligram quantities of potent APIs at the manufacturing speeds and outputs required for a blockbuster product adds another layer of complexity. Manufacturers usually overcome this hurdle by bulking out actives with excipients and using mixtures for tablet pressing or capsule filling; however, there is considerable commercial interest in developing high-speed manufacturing technologies that can dispense pure active powders. A technology that can accomplish this is Sticky Web.

According to Keith Smith, Manager of GSK's strategic technologies department, the core technology was first proposed as a result of some "shrewd research" by 42T. "GSK first appointed 42T to conduct an independent strategic technology review and to evaluate existing, credible powder dispensing approaches that could potentially be scaled for high-speed manufacturing. We already knew of some commercial systems claiming speeds of up to 15 000 doses/h, but these typically involved check weighing or volumetric techniques,

which are often unsuitable for some pure APIs that require careful handling," said Smith. "The consultancy team responded not only with a detailed review of the options, but with some great new ideas of their own — including the approach we now call Sticky Web."

Sticky Web is a scalable technology capable of accurately dispensing 0.1–100 mg of powder, with a variety of particle size distributions, onto edible or inert adhesive webs or surfaces. Accuracies are typically greater than 4% and the technology can deliver commercial manufacturing speeds of up to 60 000 doses/h.

## **Developing the technology**

Sticky Web takes its name from a simple discovery by one of 42T's engineers, based on the following theory: when a piece of adhesive parcel tape is dipped into powder and the excess shaken off, the quantity left adhering is directly proportional to the surface area of the tape. The exact quantity depends on the combined properties of the specific adhesive and powder, but even the very first tests conducted

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by 42T showed consistent coverage rates of approximately  $1.5 \text{ mg/cm}^2$  with accuracies greater than  $\pm 10\%$ .

These results led GSK and 42T to quickly establish a joint development team to create a stronger technology platform and improve the dosing accuracy — in some cases to within  $\pm 2.5\%$ . The team studied a range of APIs with widely varying physical

properties and further tested the applicability of the technology.

The development programme progressed quickly to deliver the core approach, as well as several adhesives and designs for a prototype production machine. A number of key patent applications were also secured.

### Dispensing the powder

The powder dispensing head and process are critical to the Sticky Web approach. The web, which is preprinted with adhesive further up the production line, passes around a drum where powder from a vibrating hopper is applied through drum apertures or masks to the sticky areas; any excess is tapped off using a vibrating paddle. The technique delivers uniform coverage for free-flowing powders, as well as powders that have dry clumping behaviours. It is also gentle enough for powders that require very careful handling to prevent degradation or any loss of activity.

**Figure 1** shows a powder dispensing drum and coated film web ready for die cutting into individual doses. Each 2-cm diameter area shown contains approximately 4.7 mg of API. The substrate is approximately  $30 \mu\text{m}$  thick, giving a total coated thickness of approximately  $100 \mu\text{m}$ , which allows the films to be easily rolled or folded for encapsulation or further processing. The technology also enables packaging processes to be fully merged and automated into a complete, continuous commercial production line.

**Figure 2** shows a 3D computer-aided design model of a test rig unit delivering one dose per second. Further optimization, however, could improve this rate; for example, a multiple lane production machine

with 16 lines in parallel would deliver approximately 60000 doses per hour.

### Web films, adhesives and dissolution

Aside from the powder-dispensing module, the other two main system components are the web or film carrier and the printable adhesive.

Edible or inert films have been widely used within the food processing industry for years because they are safe to ingest, while also being robust and flexible enough for standard web handling. Growing interest in thin-film drug delivery and controlled-release encapsulation technologies has also generated unusual new films and materials that can be exploited within the sticky web process.

As part of the development programme, 42T investigated existing edible pressure-sensitive adhesives (PSA) and developed a range of new substances, which offer instant tack in the dry state and gently adhere to the steel powder-dispensing drum, but also peel without leaving any residue. In addition, these new adhesives offer good powder adhesion and dissolve readily in water.

**Figure 3** shows a  $20\times$  magnification of a typical powdered area generated with one of these new adhesives; the edges are clean, and there is even powder distribution and adherence of large and small particles within the sample.

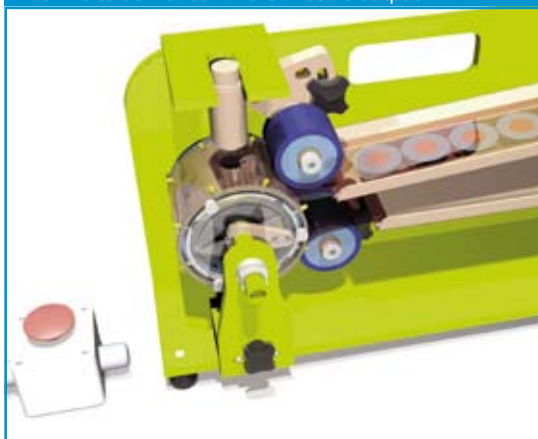
### Future developments

The bulk of development activity so far has been angled towards the pharmaceutical sector using edible flat carriers, but the adhesive could just as easily be printed onto other surfaces, including bubbles or tablets, which are then

**Figure 1:** Each 2 cm diameter circle on this web contains 4.7 mg of powder.



**Figure 2:** CAD model of a single lane test rig that can deliver 1 dose/s. Units can be combined in a multilane machine to deliver commercial-scale output.



### The author says...

- Sticky Web technology involves dispensing minute amounts of powdered APIs onto edible or inert adhesive webs or surfaces.
- The technique can be used for high-speed manufacturing and delivers accuracies typically within  $\pm 2.5\%$ .
- New films and adhesives have been developed that provide several advantages, including good powder adhesion.
- The Sticky Web approach can be scaled to virtually any application requiring high-volume dispensing of small amounts of powder.



subsequently dosed with powders. Two or more substances could even be combined in the same delivery package.

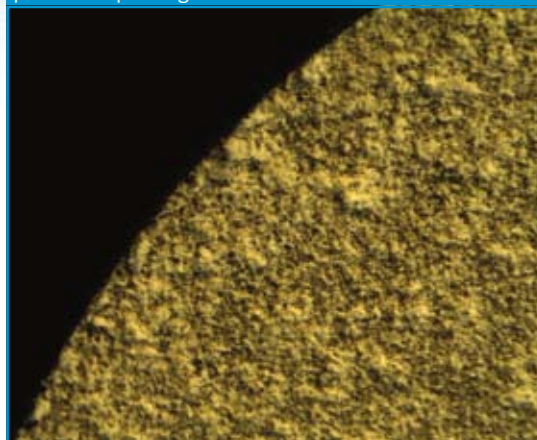
The technology is also viable for virtually any industry requiring accurate, high-volume dosing of powders to improve existing manufacturing processes or generate innovative new products or processes.

“Sticky Web offers considerable promise for high-speed production environments where online inspection systems could be used to validate every powdered area and to improve process feedback, increase efficiency and reduce costs,” said Smith.

One of the most interesting features of Sticky Web is the potential for improved release of active powders that have a tendency to agglomerate during dissolution when delivered via powder-coated films compared with capsules. Some initial development work has suggested a marked improvement, but further validation studies would be required for specific adhesive and powder combinations [PTE](#)

**Howard Biddle**  
is Managing Director of  
42 Technology (UK).  
[howard.biddle@42technology.com](mailto:howard.biddle@42technology.com)

**Figure 3:** Sticky Web delivers clean edges for precision powder dispensing.



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