UNIVERSITY OF CAMBRIDGE
Department of Chemical Engineering

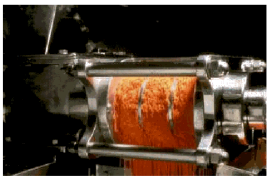
P. J. Martin* and D. I. Wilson
Department of Chemical Engineering, University of Cambridge, Pembroke St, Cambridge CB2 3RA
*pjm60@cam.ac.uk, http://www.cheng.cam.ac.uk/groups/paste. This work is supported by Syngenta.

PRODUCTION OF WATER DISPERSIBLE GRANULES BY PASTE EXTRUSION

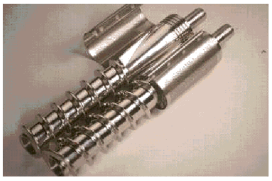
What are Water Dispersible Granules?

A variety of important agricultural and domestic products such as fertilisers and detergents are marketed as water dispersible granules (WDGs). WDGs are often manufactured by extruding a paste mixture through small diameter (0.6 - 1 mm) die holes. The resulting extrudate is then dried, sized and sorted into appropriate lengths (~10 mm). These WDGs break up rapidly on contact with water, giving a solution of the active ingredient for spraying on to fields, washing, etc.

Reverse engineering the extruder



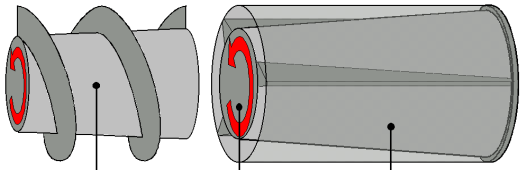
Extrusion of paste through the screen



A disassembled extruder

- Isolate significant features of paste flow through a twin-screw radial screen extruder. Total understanding of flow is reached by compiling separate features.
- Two components of flow can be isolated following the assumptions outlined below.

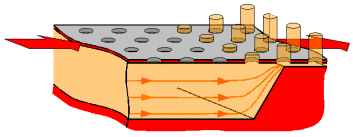
① Isolate single screw and extruder



⑤ Replace industrial paste with model paste

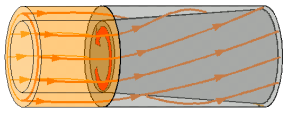
- Flow component 1 - Extrusion

Paste is extruded in the region of the nip between the blade and the screen.



- Flow component 2 - Feed

Paste flows along the length of the extruder to supply the extrusion region.

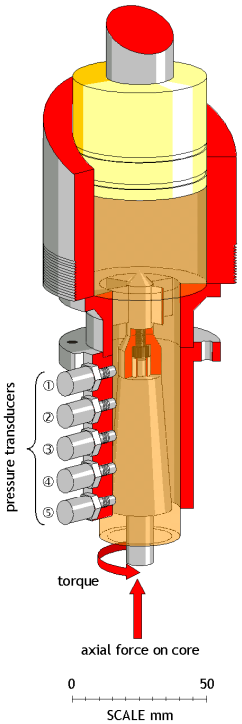


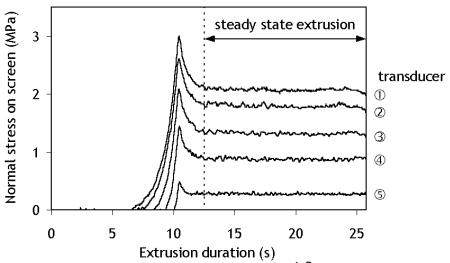
How are WDGs made?

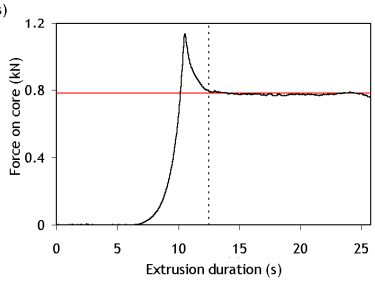
The twin-screw radial screen extruder is a proven industrial method for manufacturing WDGs. Two counter-rotating screws feed paste axially to two sets of mounted blades rotating within two cylindrical screens. The relative movement between blade and screen forces the paste to flow radially out of the screen perforations, in a manner similar to a spaghetti maker.

Modelling paste feed

- Flow along the length of the space in between the core and screen provides a supply of paste to the extrusion region.
- Feed flow has been modelled and experimentally investigated in a laboratory.
- The diagram below shows a cut away of the lab equipment used. The piston forces paste to flow around the support and then over the rotating core. The axial force and torque at the core base are measured, along with the normal stress along the length of the screen.

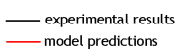


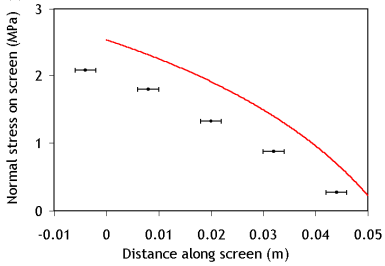




- The charts show good agreement between our experimental and model prediction results.

Results are for the case of a stationary core.
Core ∅: 15 mm - 25 mm
Screen ∅ : 30.8 mm
Screen length: 50 mm
Flow rate: 7.6 cm^3/s





What's the problem?

Current industrial designs have evolved with experience, and little fundamental research has been performed on this type of extruder. In order to overcome difficulties in the development process, and particularly to help decide whether a particular recipe can be used in these machines, we are constructing a model of the paste flow through the extruder. Existing modelling techniques are being extended to cope with the complexity of this extruder, and novel extrusion experimentation is being carried out to verify the modelling. Eventually we will be able to predict the performance of a given recipe through these complex machines.

EPSRC Engineering and Physical Sciences Research Council
Syngenta