[MS24-P17] Multi-Component Crystallisation of Agrichemicals for Continuous Manufacturing.

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According to Desiraju's definition, the role of crystal engineering is to achieve control of the physical and chemical properties of the product [1]. One of the increasingly more common methods of achieving this is by co-crystallisation of the target compound with benign co-formers which do not interfere with the active process of the target compound. This has been used in the pharmaceutical industry for sometime with great effect but has yet to be widely employed in the agrichemicals industry.

In the agrichemicals industry formulations of fungicides, insecticides and herbicides are developed with a view to optimisation of solubility, mobilisation within the soil and biological activity. These formulations can be difficult to mix, requiring the compatibility of a wide range of components to effect the desired properties of the product. Using crystal engineering principles it is possible to fine tune these properties *via* co-crystallisation of the target compounds.

Here we present the structures of a selection of commonly used herbicides and fungicides co-crystallised with a range of co-formers. The criteria for the selection of co-formers include: size matching with the target compound – to utilize optimal packing efficiency and π-π stacking interactions; complementary hydrogen-bond acceptor/donor sites and a tendency of functional groups towards forming common supramolecular synthons. Analysis of the resultant crystal structures and packing properties will highlight these supramolecular aspects, while complementary physical property measurements allow the properties of the resulting materials to be determined, including solubility and stability.

This work is carried out in the context of the current major push within industry towards the implementation of continuous manufacturing of materials. Batch manufacturing processes require a large amount of downtime for separation and preparation of the final product; this is not only costly but inefficient. In addition, the large stirred-tank reactors typically used in batch crystallisation offer low control of purity, crystal morphology and polymorphic forms. The Centre for Innovative Manufacturing in Continuous Manufacturing and Crystallisation (CMAC) is a consortium of seven Universities within the UK working with industrial partners on all aspects of the widespread implementation of continuous crystallisation for manufacturing [2].

The synthesis of the agrichemical co-crystals presented here will be optimised using a novel continuous flow crystalliser currently in development. The design of this flow crystalliser, presented here, has incorporated principles of flow chemistry to optimise control over the crystallisation process. The modular design of the flow crystalliser enables facile modification to suit the needs of the system resulting in a highly versatile apparatus with applications beyond co-crystallisation. Multiple injection points may be used for either analysis of the evolving product or as points for modification/feedback control of the system.

[1] Desiraju G. R., Parthasarathy R., *J.A.C.S.*, (1989) **111**, 8725-8726

[2] http://www.cmac.ac.uk/index.php

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