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Advancing Fertiliser Sustainability Through Green Solvent-Based Inhibitor Coatings

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ABSTRACT

Nitrogen is vital for plant growth and development, and maintaining adequate nitrogen in the soil is essential for achieving maximum yield. However, keeping nitrogen in a plant-available form can be difficult due to the biochemical transformations that occur after nitrogen is applied. Global agricultural practices account for 50% of the total ammonia lost to the atmosphere per year with over 50% of the applied nitrogen lost through different processes.

To mitigate these losses Incitec Pivot Fertilisers (IPF) utilises a urease inhibitor, to reduce ammonia losses, and a nitrification inhibitor coating, to reduce losses from other loss pathways known as nitrification and denitrification. These are delivered through three coatings: a nitrification inhibitor coating, a urease inhibitor coating and a combined urease and nitrification inhibitor coating.

Not only do the use of these inhibitors themselves strive to improve the sustainability of fertiliser use, but the design of the coatings used to deliver these inhibitors onto the fertiliser also looks to ensure sustainability and safety for the distributors and end users. IPF utilises the co-solvent systems of tetramethylene sulphone (sulfolane) and triethanolamine (TEA), and sulfolane and glycolic acid to dissolve the different inhibitors for delivery onto the fertiliser granules.

Glycolic acid and sulfolane are Green Solvents, which are environmentally friendly solvents which were developed in an effort to reduce the environmental impact of industrial solvent use. Green solvents are characterised by their low toxicity, non-volatility, biodegradability and sustainability. This makes glycolic acid and sulfolane perfect alternatives to highly toxic solvents due to its non-volatile and environmentally friendly nature. Sulfolane, in particular, is ideal for Agricultural use as nitrogen-, phosphorus- and sulfate-rich environments, which fertiliser foster, increase its biodegradation rate. TEA isn't classed as a Green Solvent, due to its non-sustainable source, however it too is biodegradable, non-volatile and possesses low toxicity. TEA does not bioaccumulate and as a result is commonly utilised in many industrial products such as cosmetics, liquid laundry detergents, dishwashing liquids, general cleaners and hand cleaners. The solvents utilised in IPFs inhibitor coatings are in stark contrast to the highly toxic N-methyl-2-pyrrolidone (NMP), which is found in many leading inhibitor products in the Australian market.

KEY WORDS

Sustainability, Environment, Fertilisers, Emissions Reduction, Green Solvents

BIOGRAPHY

Timothy Hughes is a R&D Chemist and Lab Manager at Incitec Pivot Fertilisers, responsible for product development of coating formulations and liquid fertilisers. He holds a PhD in Chemistry from Monash University and a Bachelor of Chemical Engineering from Curtin University. Timothy is an inventor on six patents in the field of Agriculture from his current tenure at Incitec Pivot. As an honorary fellow at the University of Melbourne, Timothy is heavily involved in the ARC Research Hub for Smart Fertilisers providing insight into commercial applications of fertilisers to the University researchers shaping next generation technologies into commercially-viable products.

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