Turning Waste to Value: Harnessing Benefits from Recycled Nappy SAP

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Every year, 1.5 billion disposable nappies end up in Australian landfills. These nappies consist of three main components: organic waste (human urine and faeces), superabsorbent polymer (SAP, gel-like materials that retain liquids), and plastic components (outer waterproof layer, tapes, and elastics). This represents a massive waste problem. CSIRO, KCA, and partners are pioneering a fully circular and scalable solution to recycle disposable nappies in Australia.

The Nappy Loop project

Based on the first trial (Figure 1), the project team has confirmed anaerobic digestion to be a viable option in converting the fluff pulp and other organic components of the soiled nappies (after separating plastics) into nutrient-rich compost and biogas (Kumar and Muster, 2023).

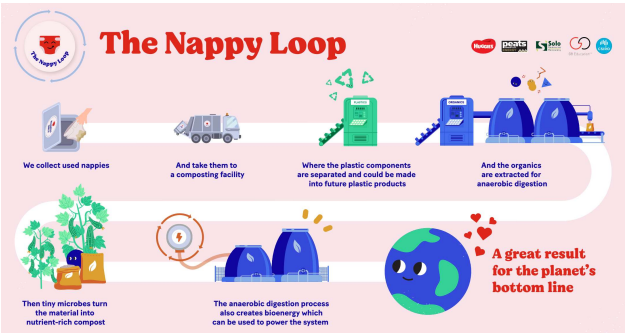

Figure 1: Overview of the Nappy Loop project

Super Absorbent Polymer (SAP)

- Sodium polyacrylate is commonly used as SAP in many disposable nappies.
- This study focuses on exploring the benefits that SAP, recovered from used nappies, can bring to soil, contributing to more sustainable and circular waste management.
- An overview of toxicity tests is illustrated in Figure 1. Recycled SAP characteristics are given below.

pH	7.3
Calcium (mg/L)	9.9
Magnesium (mg/L)	1.9
Potassium (mg/L)	26
Sodium Total (mg/L)	380
Ammonia-N (mg/L)	18
Nitrogen - Total Kjeldahl (mg/L)	39
Orthophosphate-P (mg/L)	17
Sulphate (mg/L)	63

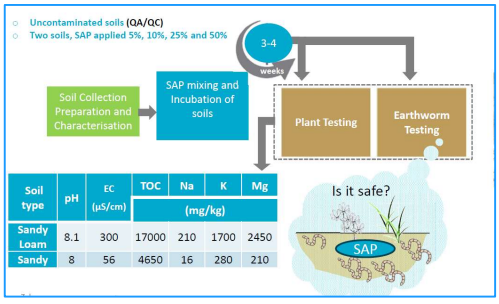

Figure 2: Overview of toxicity studies using recovered SAP

Toxicity of SAP to earthworm and plants

- Plant experiments broadly followed OECD guidelines for testing chemicals (208: Seedling Emergence and Seedling Growth Test; and 227: Vegetative Vigour Test).
- Lupin (*Lupinus albus - Jurien*) and perennial ryegrass (*Lolium perrene*) seeds were added to soil containing recovered SAP at 1-50%. Seed germination, plant growth as root and shoot length were measured during 28-day tests (Figure 3).

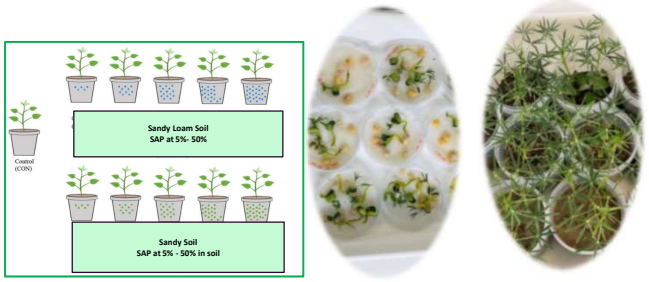

Figure 3: Lupin and Ryegrass testing with recovered SAP in sandy and sandy loam soils

- The earthworm uptake and toxicity studies followed OECD guidelines for testing chemicals (222: Earthworm Reproduction Test), where earthworm *Eisenia fetida* were exposed to soils spiked with recovered SAP at 5-50% (Figure 4).
- Earthworm survival and weight was evaluated after 28-day exposures.

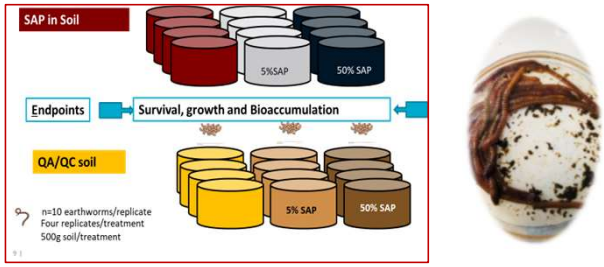

Figure 4: Earthworm toxicity testing with recovered SAP in sandy and sandy loam soils

Interim Findings

- Incorporating recovered SAP into both sandy loam and sandy soil does not raise trace element levels beyond ecological and human health safety thresholds.
- Preliminary toxicity test results elucidate the safety of the recovered SAP. Further data analysis is currently underway.
- Our laboratory trial is pivotal in illustrating the safety of recycled SAP in compost or soil amendment products
- This feasibility study will provide confidence for the potential for large-scale recycling programs to effectively address the increasing volume of disposable nappy waste.

FOR FURTHER INFORMATION

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REFERENCES

Kumar and Muster (2023) Nappy Recycling Trial: Technical feasibility Assessment

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