

# Clearing up a material compatibility mess: Testing detergent wipes for environmental stress cracking of plastics

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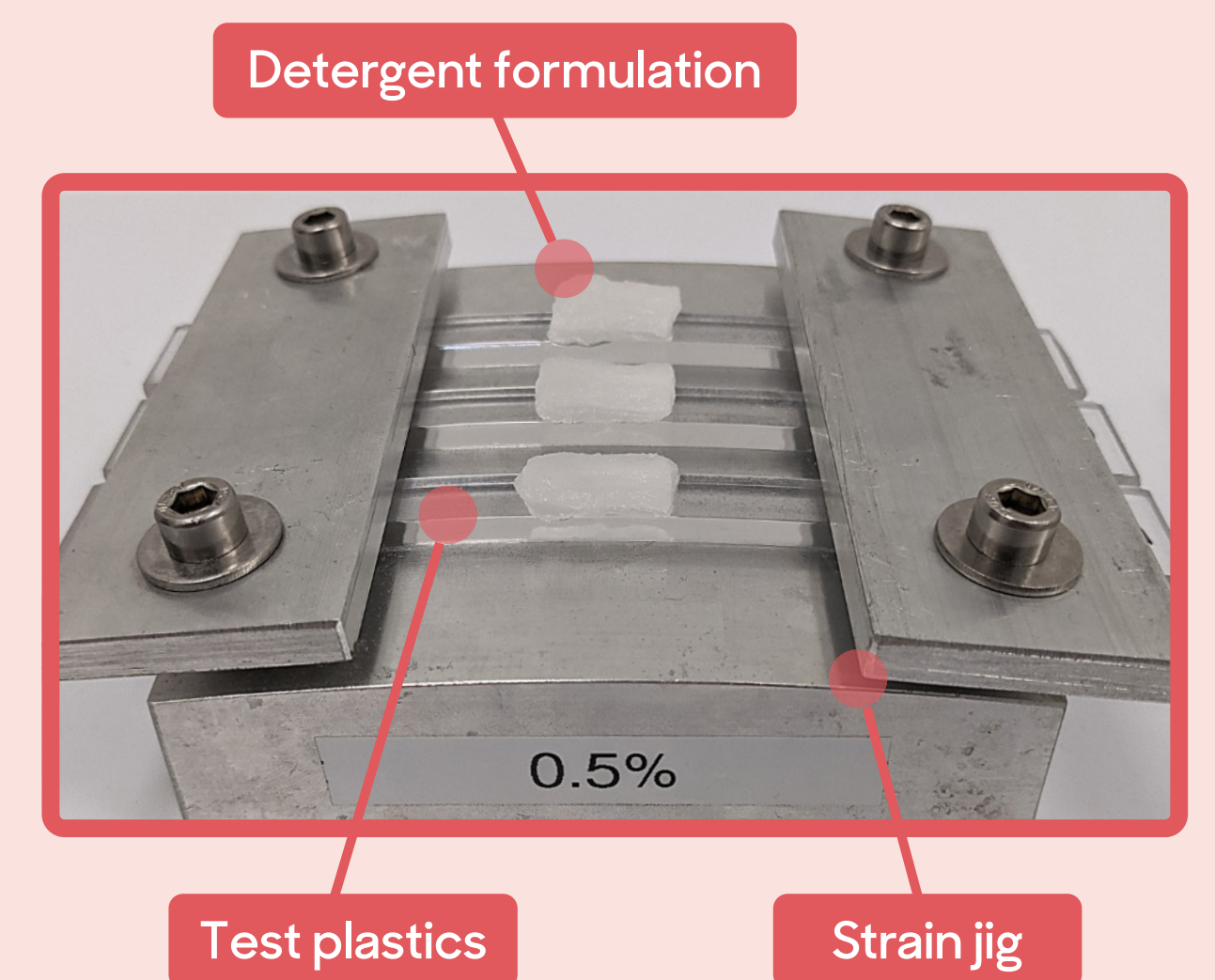
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## Background

- 1 Detergent wipes are intended to physically remove and retain organic matter and contamination from surfaces and medical devices. Transfer of pathogens to multiple surfaces by detergent-based wipes has been demonstrated<sup>1</sup>
- 2 Guidelines from NHS England<sup>2</sup> and NHS Scotland<sup>3</sup> outline what and how to clean and NHS Supply Chain provides a framework for sourcing detergent wipes, but none provide specifications or standards on the efficacy and compatibility of detergent wipes
- 3 Incompatible detergents cause Environmental Stress Cracking (ESC), resulting in device recalls, the premature failure of equipment and a potential reservoir for pathogens<sup>4</sup>
- 4 There are currently no requirements from the NHS for detergent products to demonstrate compatibility with the materials found in the surfaces on which they are used

## Methods

- Thirteen plastics commonly used in medical devices were subjected to testing with three different detergent wipes in accordance with BS EN ISO-22088-3:2006 – 'Determination of Resistance to ESC - Bent Strip Method'<sup>5</sup>
- This method offers a robust and reproducible way of evaluating ESC following exposure to detergent formulations
- In the absence of visual damage such as crazing or cracking, the test plastics were assessed for invisible damage by testing their strength through tensile testing



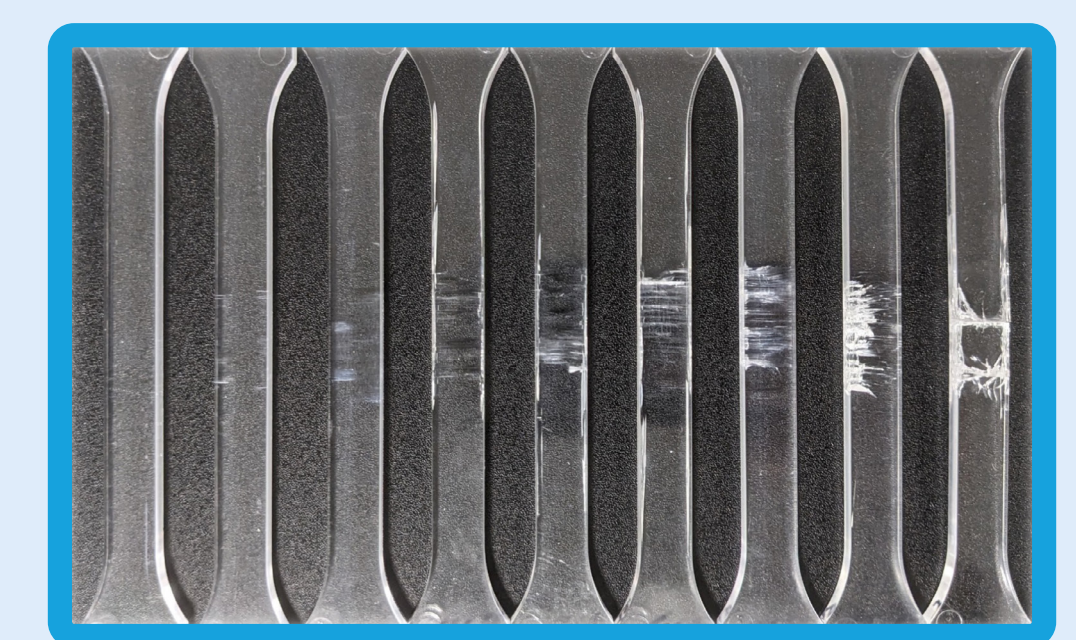
**Figure 1:** Using a strain jig the test plastics (n=3) were held at a 0.5% strain and exposed to fluid extracted from the detergent wipes using a 'wet patch' method. Visual observations were made throughout a 7 day repeat exposure

## Results

Polymer	PC			PC/ABS blend			ABS		PMMA		PS	PP	
	Calibre 603-3	Calibre 303-15	Emerge 8701HH	Calibre 2061	Pulse A35-105	Mablex 451	Emerge 7100	Magnum 8391	Terlux HD 2812	Altuglass VM	Sumipex AME	Styron 678E	Exxon PP1014H1
Control - Water	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Detergent Wipe A	Pass	Yellow	Yellow	Red	Red	Red	Red	Red	Red	Red	Red	Red	Pass
Detergent Wipe B	Pass	Pass	Yellow	Pass	Pass	Red	Red	Red	Red	Red	Red	Pass	Pass
Detergent Wipe C	Pass	Pass	Yellow	Red	Pass	Red	Yellow	Pass	Pass	Yellow	Pass	Red	Pass

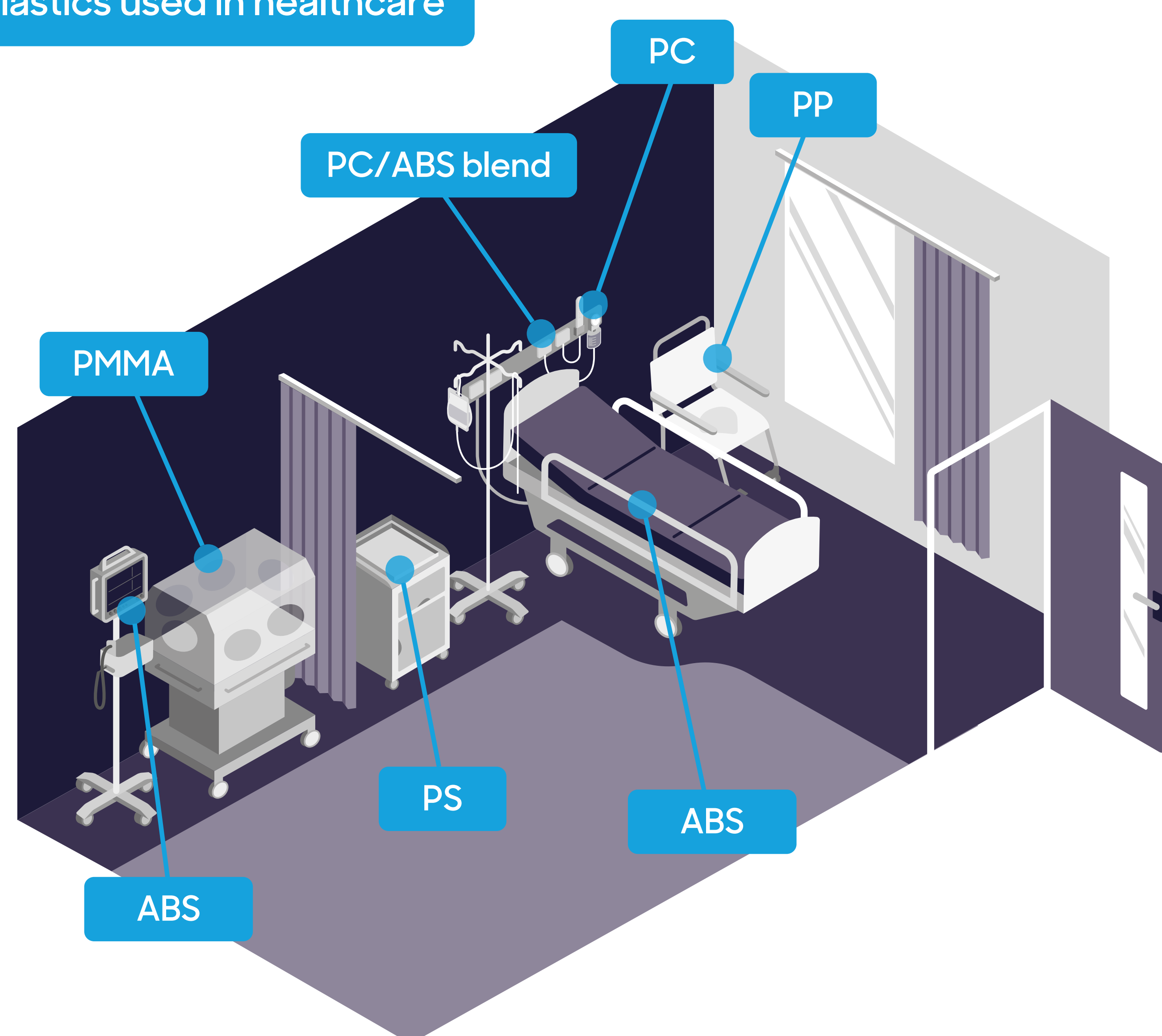
- Pass - No cracks, crazes or tensile weakening
- Invisible damage - No cracks or crazes, but weakening of plastic tensile properties observed
- Visible damage - Cracking or crazing (cracks that have not yet reached the surface)

- All 3 ready-to-use detergent wipes contained ESC agents that induced cracking in multiple plastics at strain levels (0.5%) typically found in medical devices
- Test plastics made from amorphous polymers such as acrylonitrile butadiene styrene (ABS), polycarbonate (PC), polymethyl methacrylate (PMMA), and polystyrene (PS), were particularly susceptible to damage
- The semi-crystalline polymer polypropylene (PP) was the only test plastic to not be damaged by any of the detergent wipes



Increasing ESC Effect →

## Plastics used in healthcare



## References

1. Ramm L, et al. Am J Infect Control. 2015;43:724-8
2. NHS England, National Standards of Healthcare Cleanliness 2021 (accessed May 2023)
3. NHS Scotland, National Cleaning Services Specification 2016 (accessed May 2023)
4. MHRA, Ensure detergent and disinfectant wipes are compatible with the device. MD/2013/019 2014 (accessed May 2023)
5. International Organization for Standardization, Plastics - Determination of resistance to environmental stress cracking (ESC) - Part 3: Bent strip method. ISO 22088:2006

## Conclusions

- 1 Detergent wipes used by the NHS demonstrate the ability to cause damage to medical devices through environmental stress cracking
- 2 In the absence of detergent specifications from NHS England, NHS Scotland and NHS Supply Chain, we propose the following considerations for IPC professionals when using detergent wipes

## Implications for Procurement

- a Material compatibility is a critical factor in procuring safe and efficacious detergent wipes
- b BS EN ISO22088-3:2006 provides a robust, reproducible method for assessing material compatibility and could be included in the NHS SC Framework
- c This 'Bent Strip Method' is realistic as it mimics the natural, inherent strain found in moulded plastics and tests chemical compatibility under these conditions

## Implications for IPC

- a ESC agents in detergent wipes are an unrecognised cause of damage to plastics, which can render them impossible to clean
- b Manufacturers of medical devices should indicate which detergents are compatible with their items
- c Manufacturers of detergent products should be able to demonstrate compatibility with a range of plastics in common use and clearly indicate which plastics the detergent may cause damage to