



# Solvent Extraction of Chemical Contaminants in PCR Films



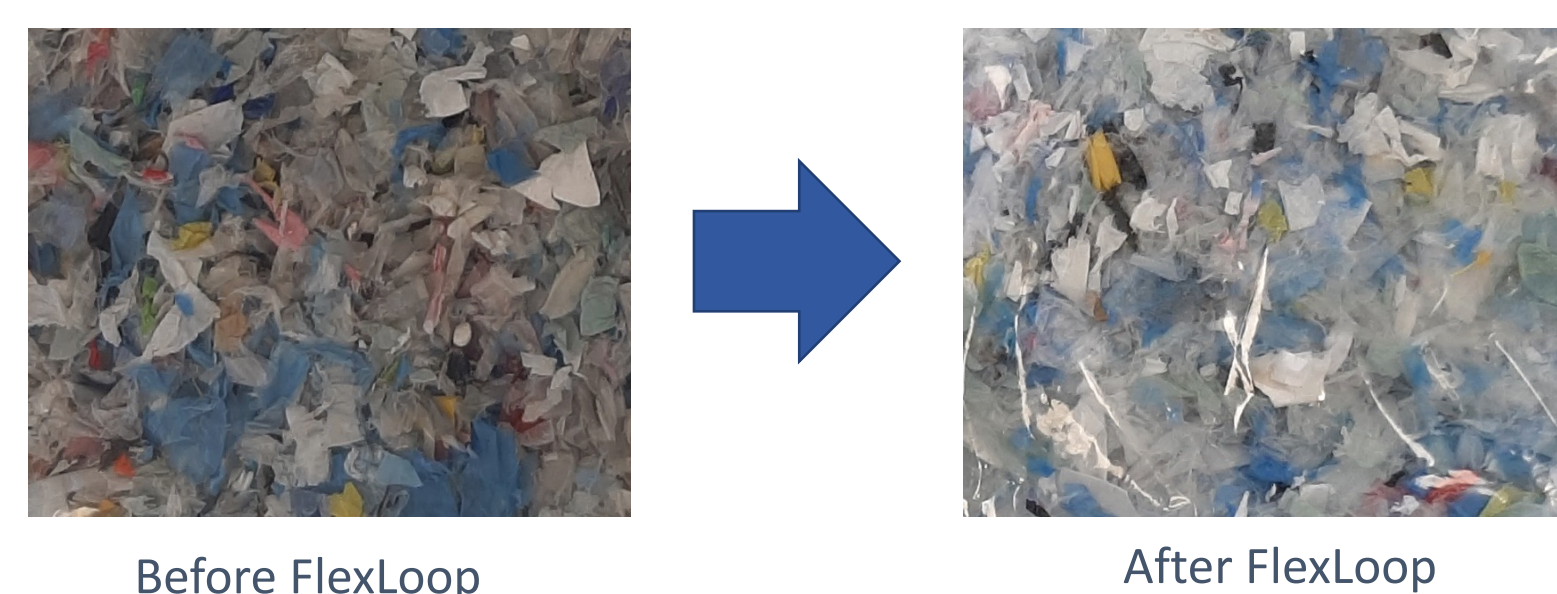
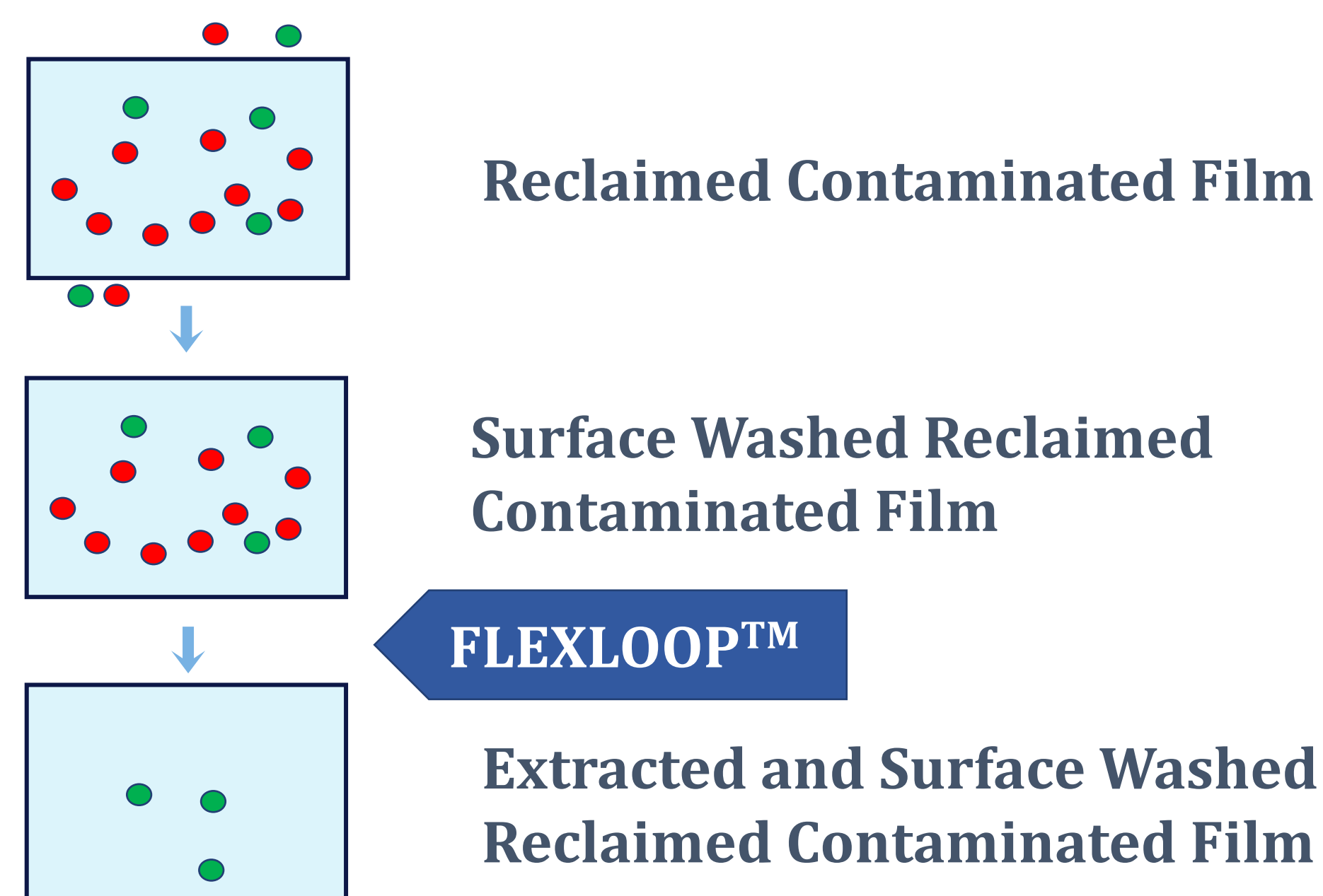
## FLEXLOOP™

### Objectives

1. Determine the constitutive parameters defining the movement of species during the extraction process: diffusivity, mass transfer coefficient and equilibrium partitioning
2. Explore usage of adsorbents to improve efficiency of extraction process

### Background

FLEXLOOP™ is a new solution for removing chemical contamination from PCR Film



### Why it's important

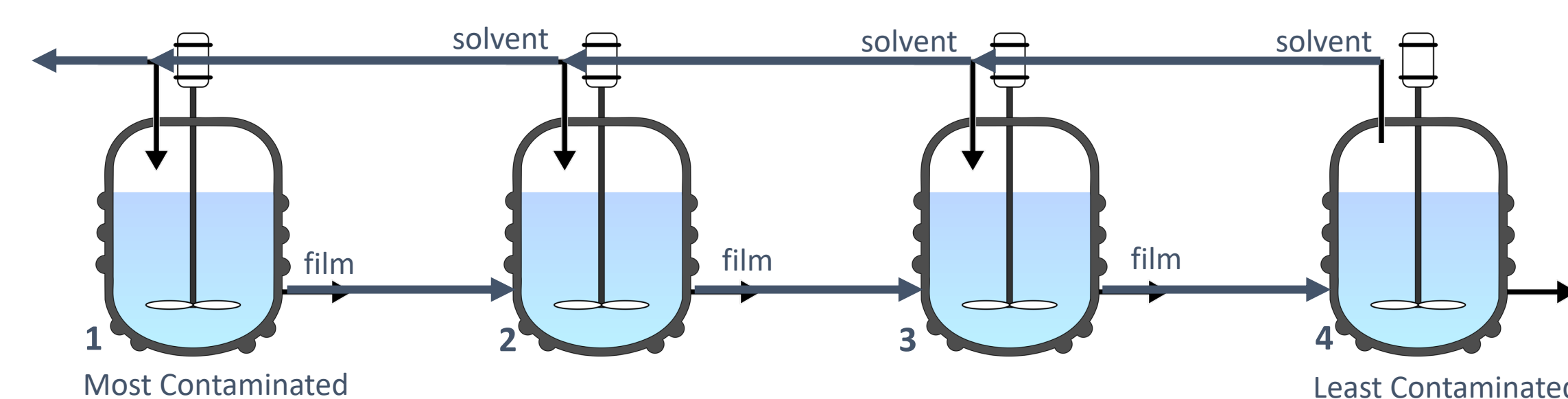
- Ambition 2030 goals state that P&G will reduce global use of virgin plastics in packaging by 50%
- FLEXLOOP™ provides a safe, less complex alternative to dissolution or depolymerization recycling, while ensuring safe, low-chemical contamination films

## Overview / Method

### 4-tert-pentyl-phenol

### Bisphenol A

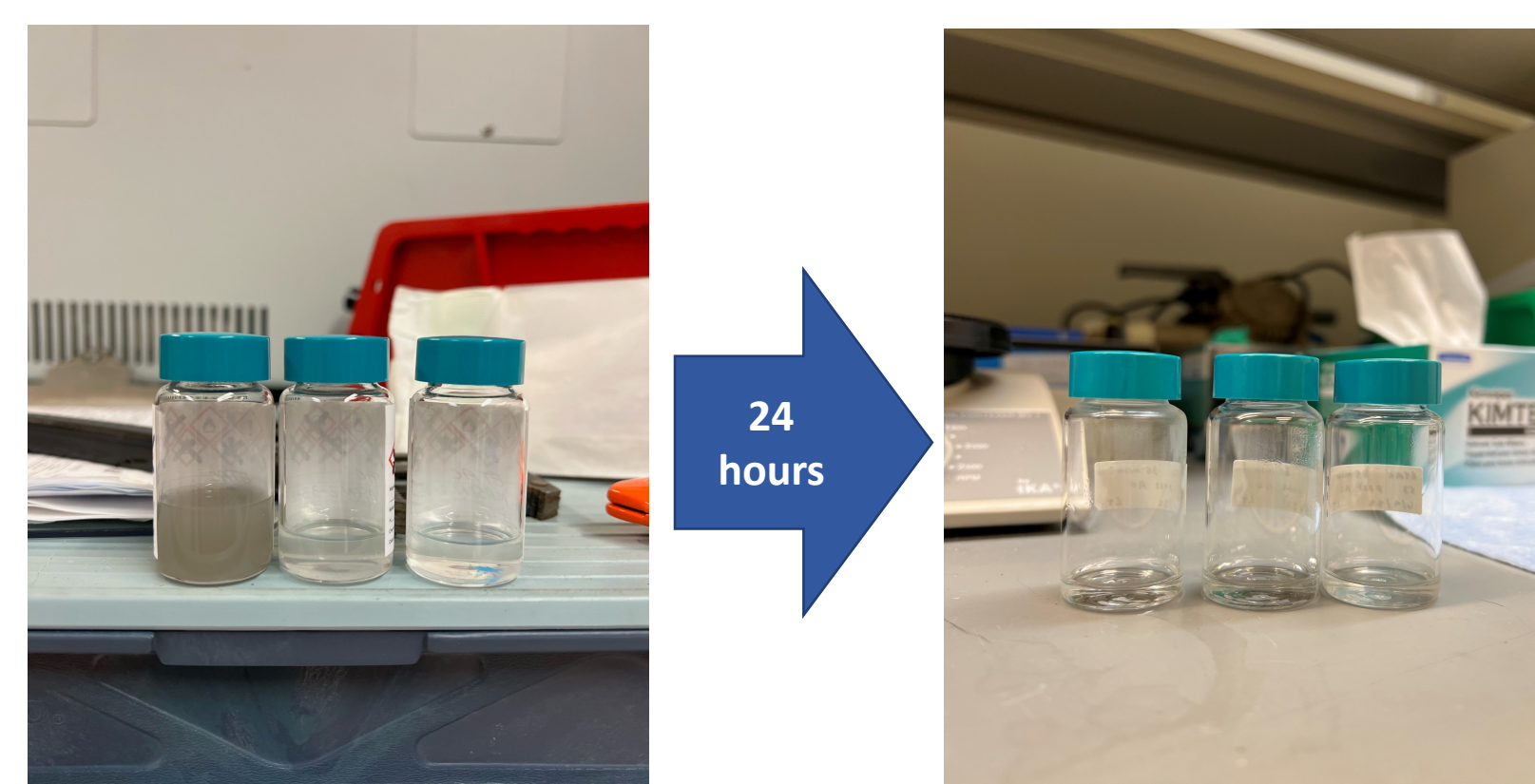
### Isononyl phenol



The FLEXLOOP™ process is made up of a series of four 35-minute extraction stages, where the film-solvent interface is allowed to reach equilibrium. Clean solvent is introduced at each stage to increase extraction of our species of interest (SOI).

	Typical Virgin Film	Typical Film PCR	Typical Film PCR After FLEXLOOP™
Pesticides	< LOQ	~20 X LOQ	< LOQ
Alkylphenols	< ~100 X LOQ	~6,000 X LOQ	< ~20 X LOQ
Bisphenol A	< LOQ	~6,000 X LOQ	< ~20 X LOQ
Dioxins/PCBs	< LOQ	~400 X LOQ	< ~2 X LOQ
Phthalates	< LOQ	~700 X LOQ	< ~2 X LOQ

## Solvent Cleansing with Adsorbents



Conc (ng/mL)	4-tert-pentyl-phenol		Bisphenol A		Isononyl phenol	
Stage 1	507	57	42.5	<LOQ	498	<LOQ
Stage 2	570	<LOQ	88.5	<LOQ	548	<LOQ
Stage 4	548	<LOQ	91.8	<LOQ	453	<LOQ

Conclusions: Activated carbon (AC) is effective at removing color, haze and SOI concentration from used ethyl acetate solvent. This could be used potentially in a packed bed column to remove these species from the solvent for reuse. Other options I've tested: larger sized AC, zeolite.

## Consumer Study

Goal: Understand consumer perception of PCR, assumptions about recycled materials and areas of greatest concern

Generate consumer-driven recommendations for PCR implementation

- Methods: 7 in-person panelist interviews – identify as eco-conscious



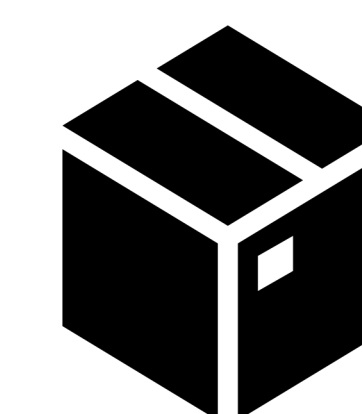
1

Claims Assessment



2

Material Acceptance



3

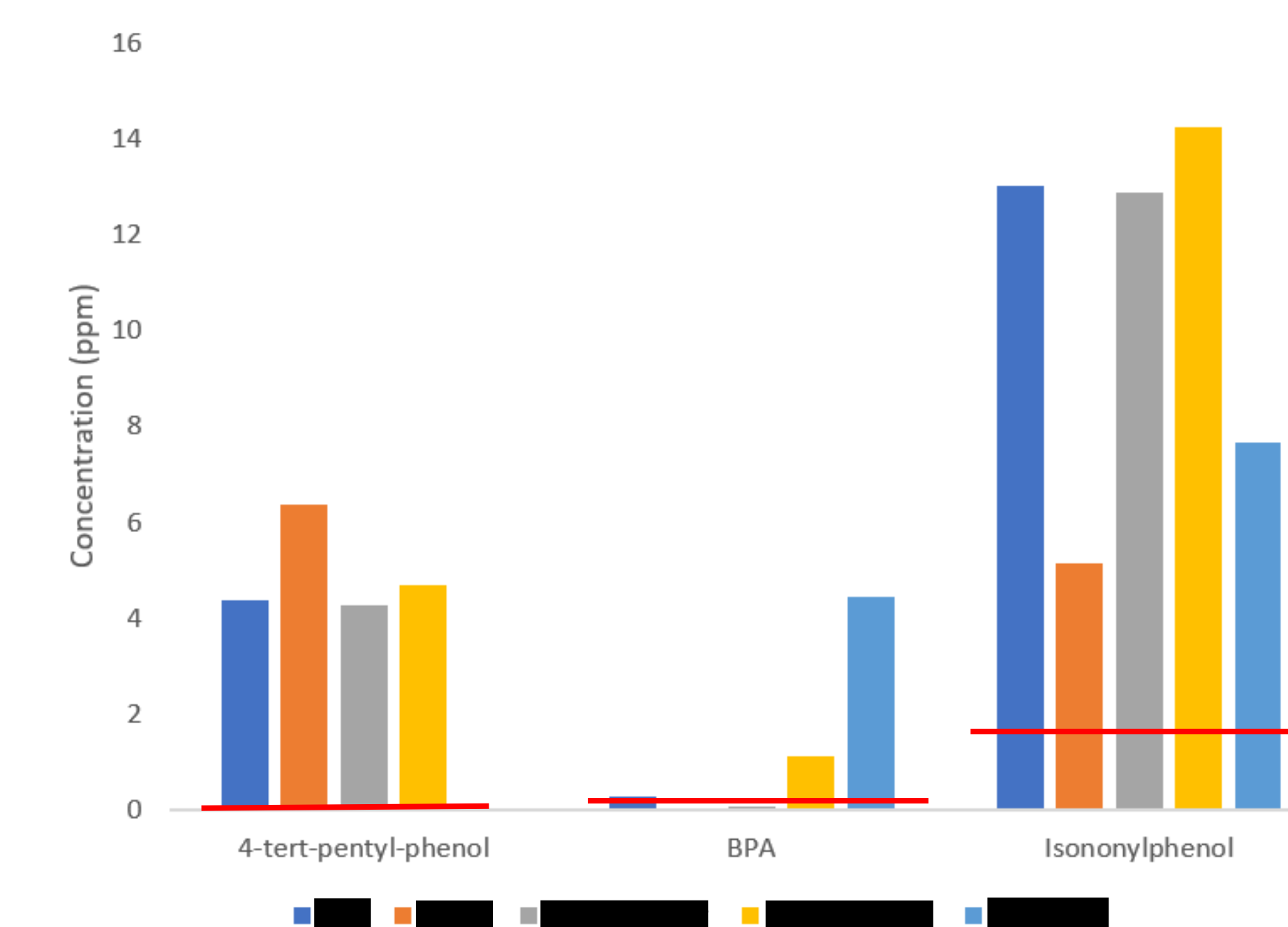
Material Check

## PCR Fingerprint

### Objectives

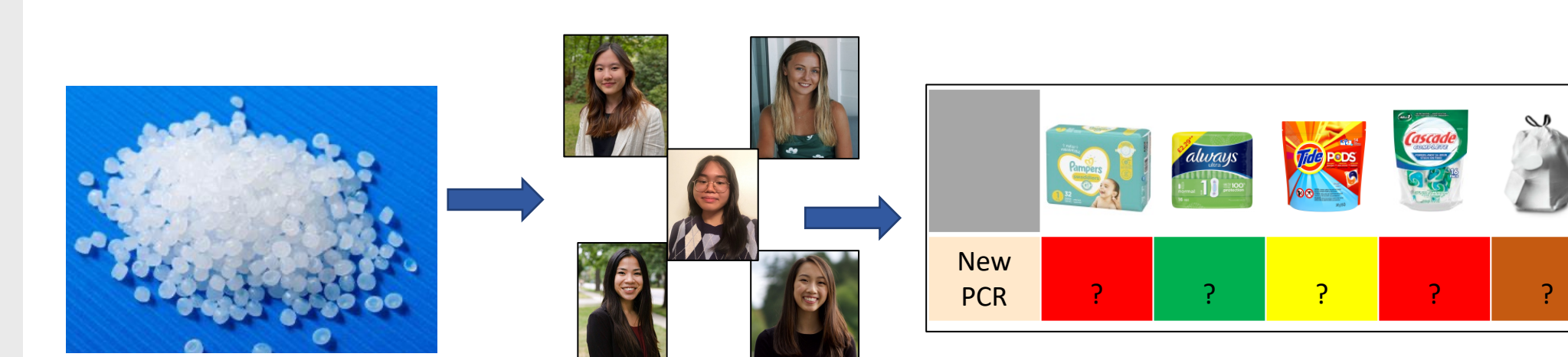
1. Generate "heat map" to predict likelihood of success for PCR in various P&G packaging applications
2. Develop decision tree for identifying contaminants in PCR film

## SOI Presence in PCR



SOI concentrations in the current in-market PCR resins are much higher than the acceptable levels for P&G packaging, especially for sensitive applications like Baby and FemCare. Using FLEXLOOP, we can reduce these values to well below the acceptable limit, ensuring safe usage of PCR in P&G products.

## Team Deliverable



New PCR

Lab Tests

Heat Map

We recommended a series of simple lab tests that translate to a "heat map" where users can see in what applications a specific PCR may be successfully used.