Bio Bind in Pavement Stabilisation

Keira Offer, Assistant Lead – Pavements and Stabilisation

BSc

Road Science

AustStab
Pavement Recycling and Stabilisation Association

About Bio Bind

- 100% renewable
- Non-soluble in water
- Non-hazardous
- Non-toxic
- Non-corrosive
- Non-flammable


Image: Road Science 2024

Aim of the study

- Bio-based stabilisation Vs traditional stabilisation
- Increase pavement climate resilience
- Calculate potential CO2e reduction

Renewable Bio-based products into resilient pavements

Methodology: Techniques

FOAMED

Image: Wirtgen GmbH (2019)

- Bitumen — 180°C
- Bio Bind — 105°C
- Bitumen Bio Bind Blend — 135°C

EMULSION


Image: DenimoTech (2023)

- Bitumen — 140 °C
- Bio Bind — 90 °C

STRAIGHT ADDITION


Image: Road: Science Product Development Hub

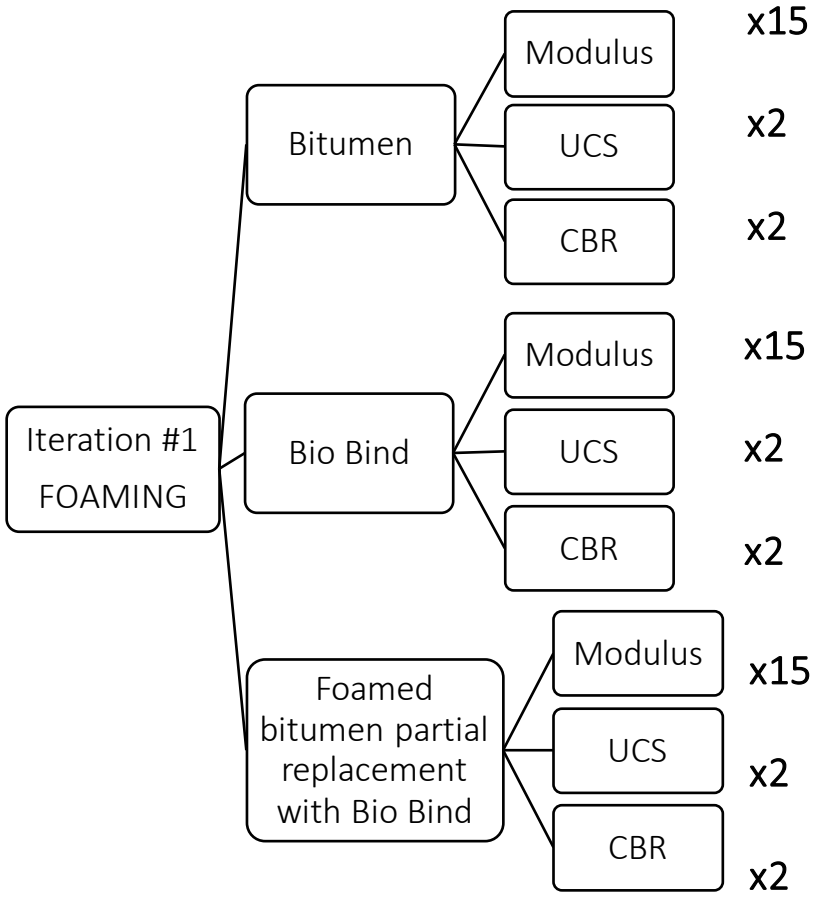
- Bio Bind — 90°C

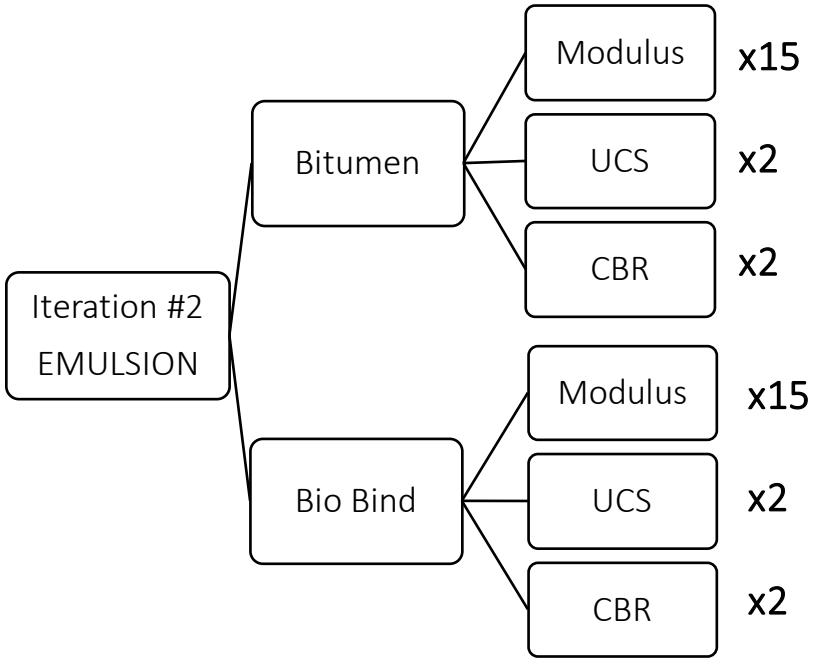
Class 3 crushed rock + 1% GP cement

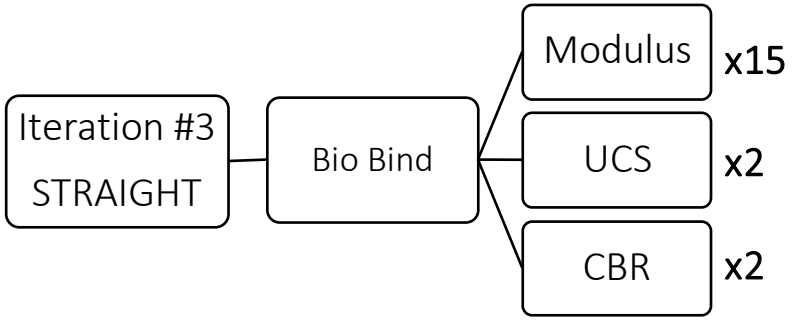
Methodology: Nominated Tests

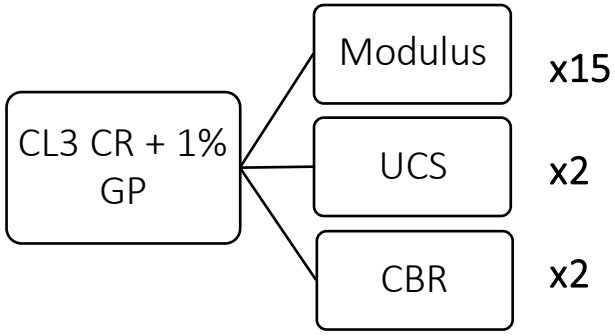
- **Resilient Modulus**
  AGPT T305
  Initial, 3 day cured, 7 day cured
- **Unconfined Compressive Strength (UCS)**
  AS 5101.4
  7 day cured
- **California Bearing Ratio (CBR)**
  AS 1289.6.1.1
  4 day soaked

Methodology: Experimental Plan









Total Tests = 133

Iteration 1: Foamed Binder

Decarbonisation potential

- Reduce handling and mixing temperatures
- Reduce the amount of bitumen

Foamed Binder Type	Mixing Temp °C	CO_2e ($kgCO_2/m^2$)
Bitumen	180°C	↑ 15.3
Bio Bind	105°C	↓ -21.5
Bitumen partial replacement with Bio Bind	135°C	↓ -3.2

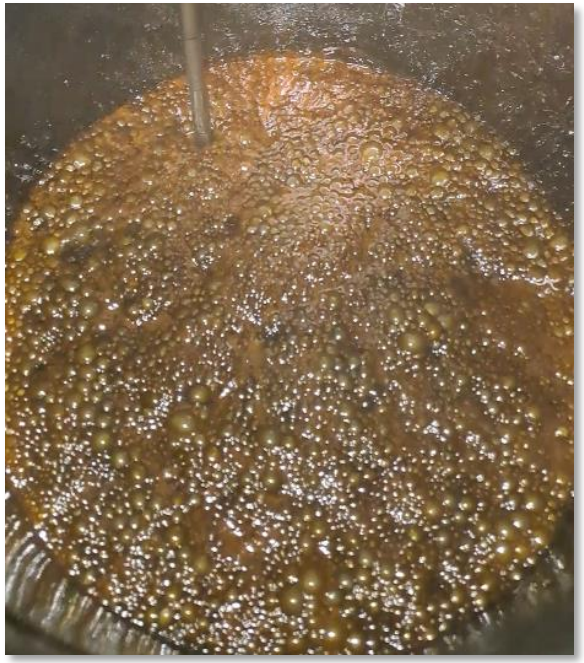
Iteration 1: Foaming Characteristics

Foamed bitumen
Expansion Ratio = >10
Half Life = >20 sec

180°C

Foamed Bio Bind
Expansion Ratio = <5
Half Life = N/A

105°C



Foamed bitumen partial replacement with Bio Bind
Expansion Ratio = 8-15
Half Life = 10-15 sec

135°C

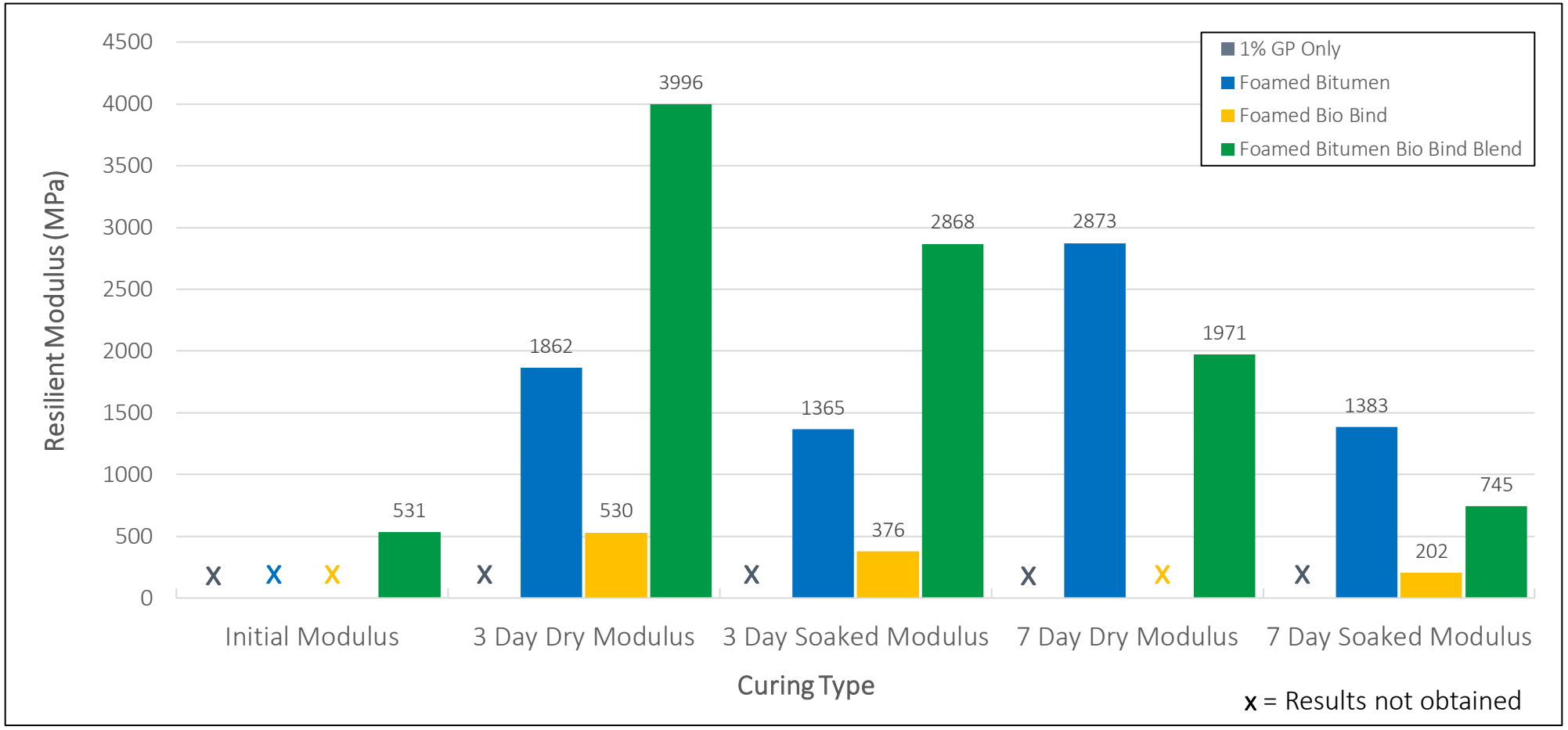
Iteration 1: Dispersal

Foamed bitumen

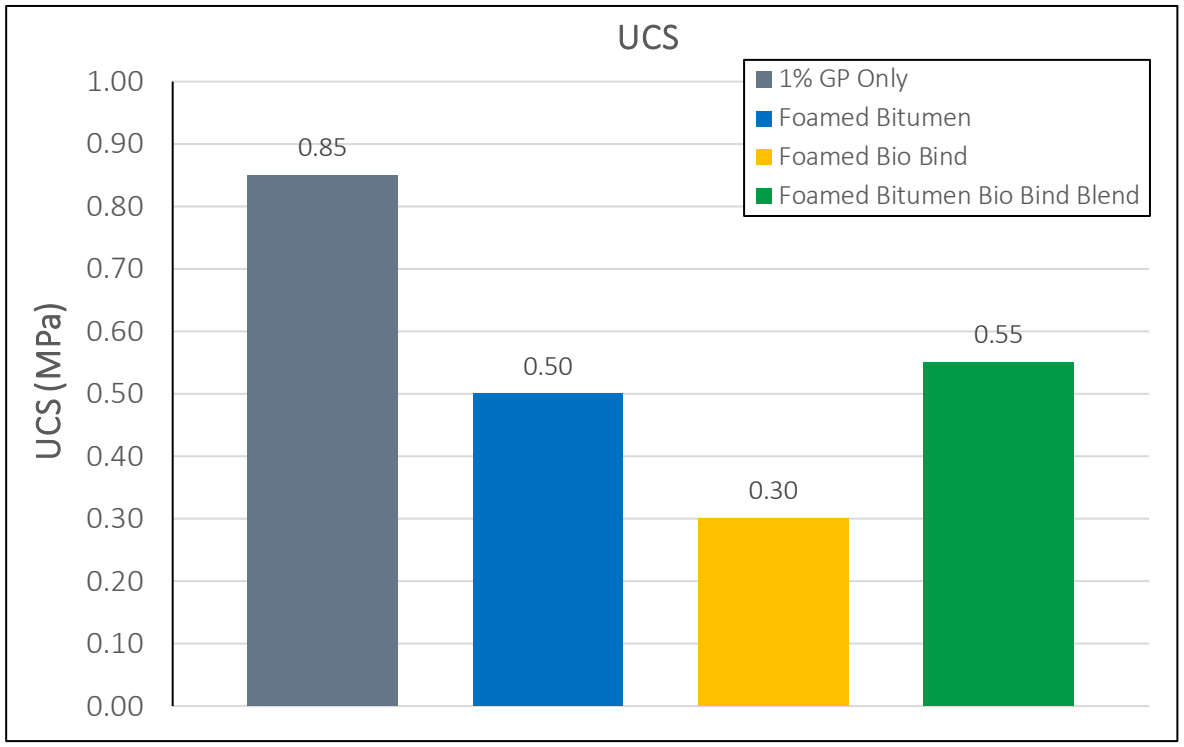
Foamed Bio Bind

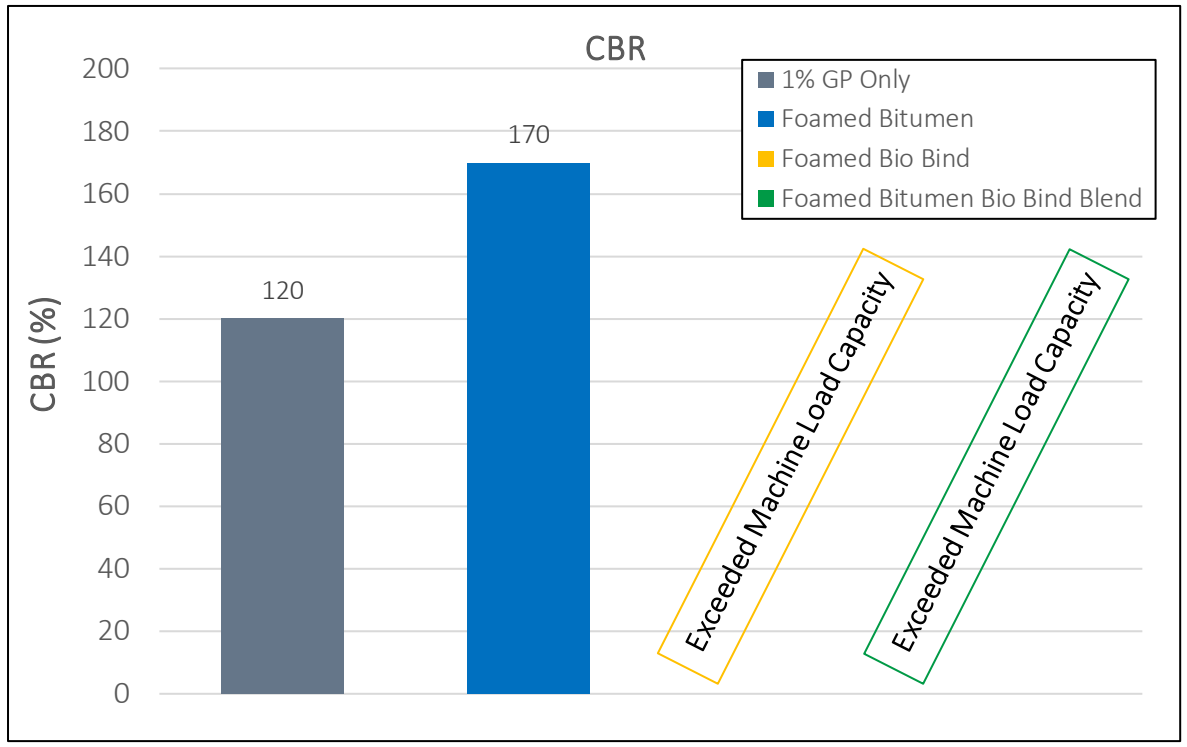
Foamed bitumen partial replacement with Bio Bind

Iteration 1: Resilient Modulus Summary



Iteration 1: UCS & CBR Results





Iteration 2: Emulsion

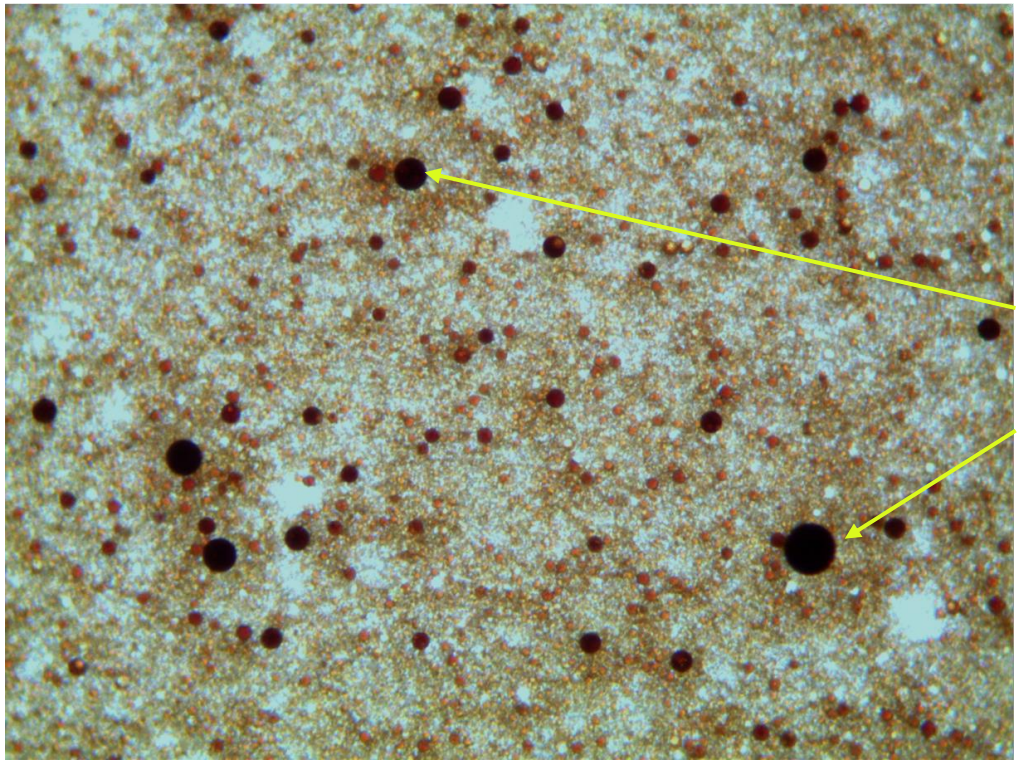
Decarbonisation potential

- Lower heat/energy required during manufacture
- Reduce reliability on bitumen

Emulsion Type	Manufacture Temp °C	Mixing Temp °C	CO_2e ($kgCO_2/m^2$)
Bituminous	140	Ambient	↑ 12.8
Bio Bind	90	Ambient	↓ -21.2

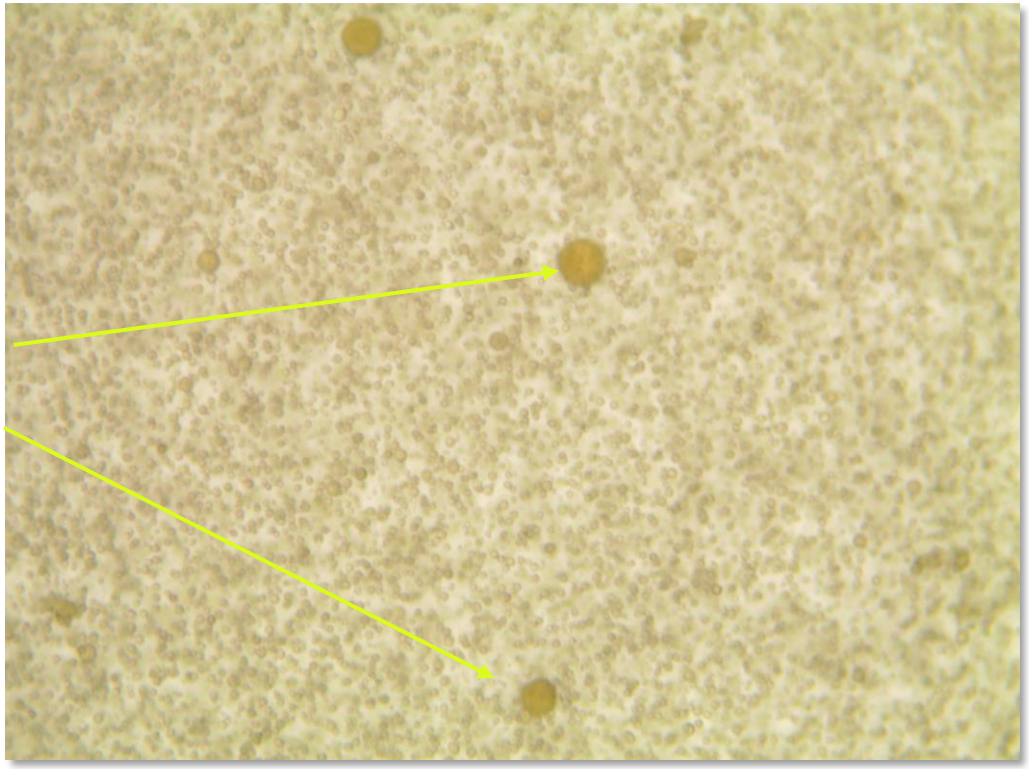
Iteration 2: Emulsions

Bitumen Emulsion



Solid particles 2-4µm

Bio Bind Emulsion

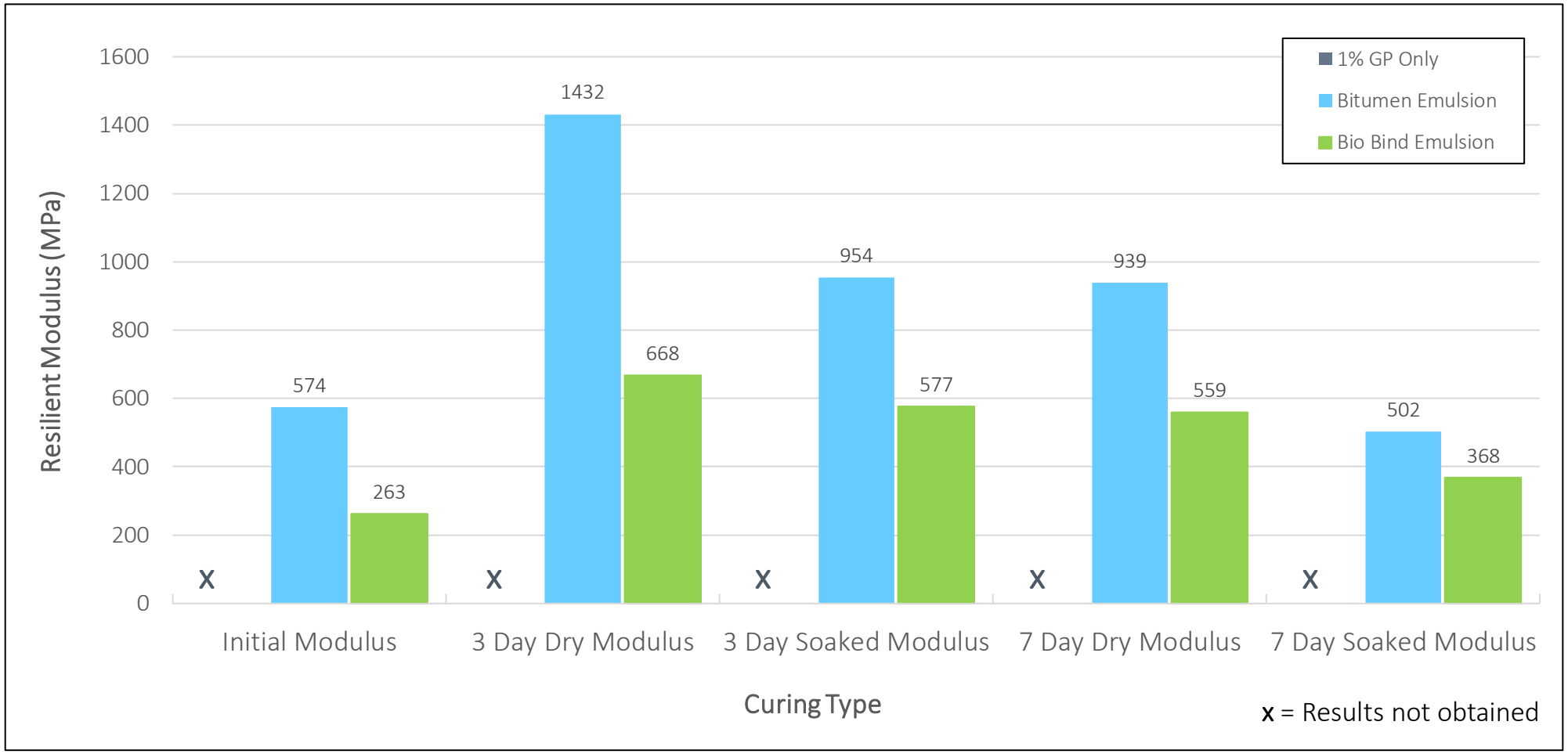


Iteration 2: Dispersal

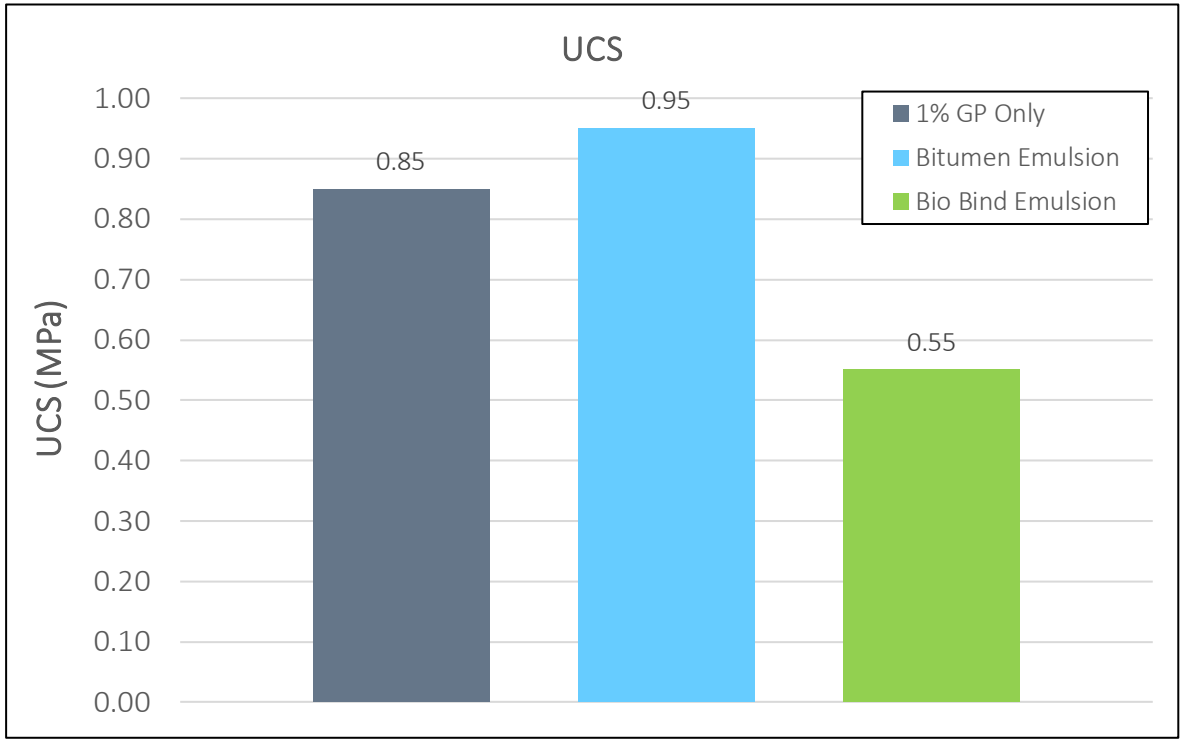
Bitumen Emulsion

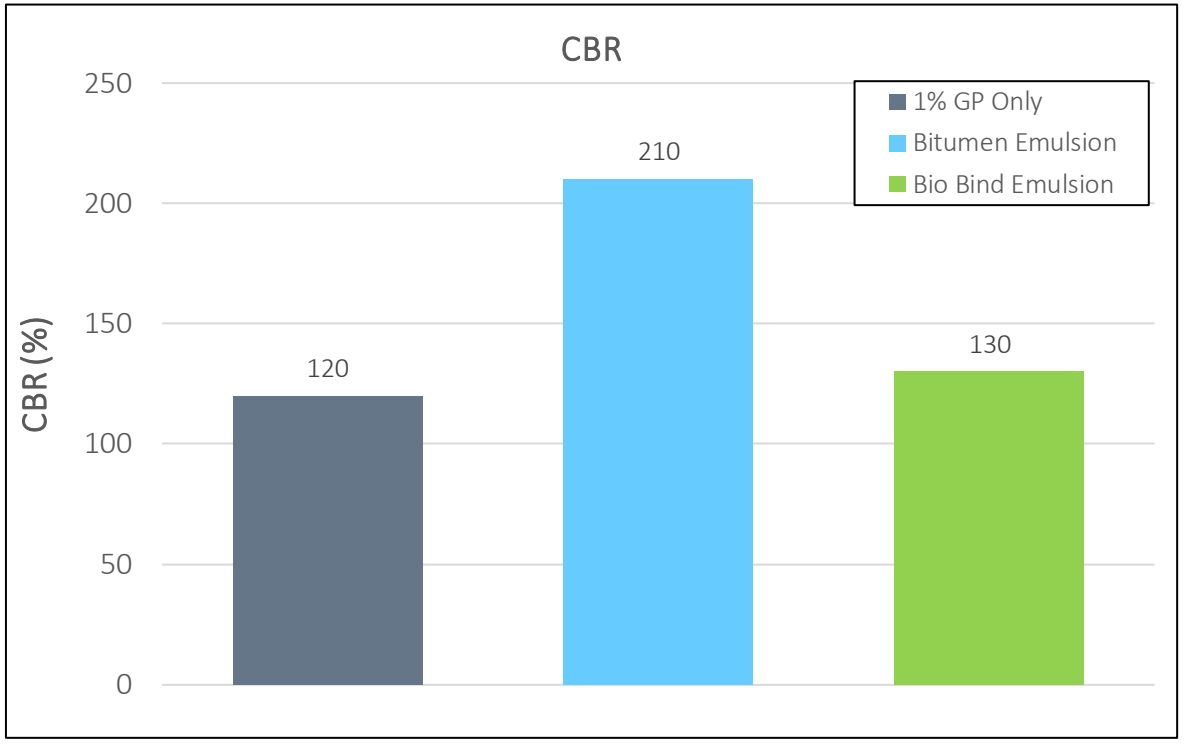
Bio Bind Emulsion

Iteration 2: Resilient Modulus Summary



Iteration 2: UCS & CBR Results





Iteration 3: Straight Bio Bind

Decarbonisation potential

- Minimise processing
- Minimal specialised equipment required for construction
- Reduced temperature

Emulsion Type	Mixing Temp °C	CO_2e ($kgCO_2/m^2$)
Straight Bio Bind	90°C	↓ -23.1

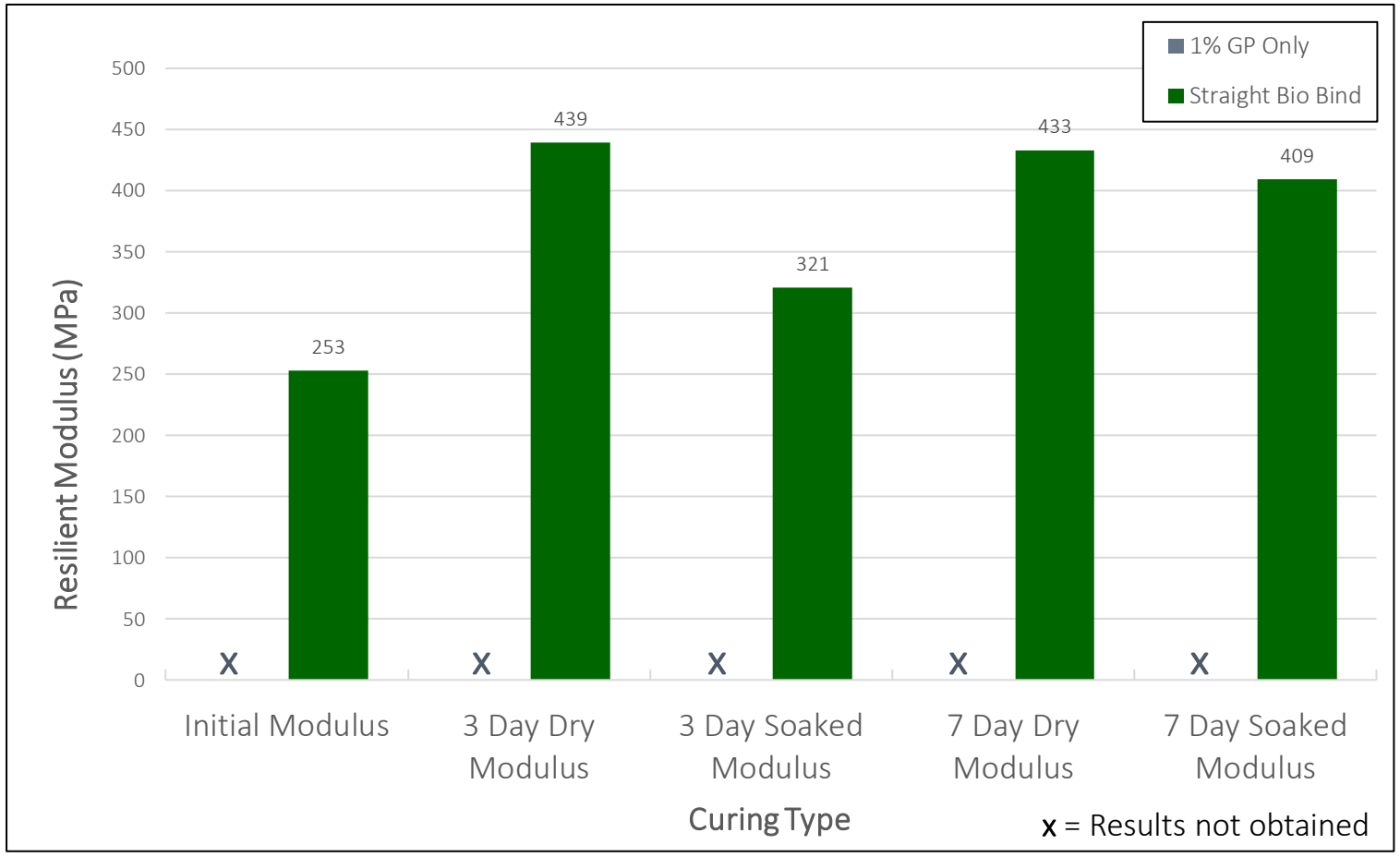
Iteration 3: Straight Bio Bind Mixing

Bio Bind at 90°C

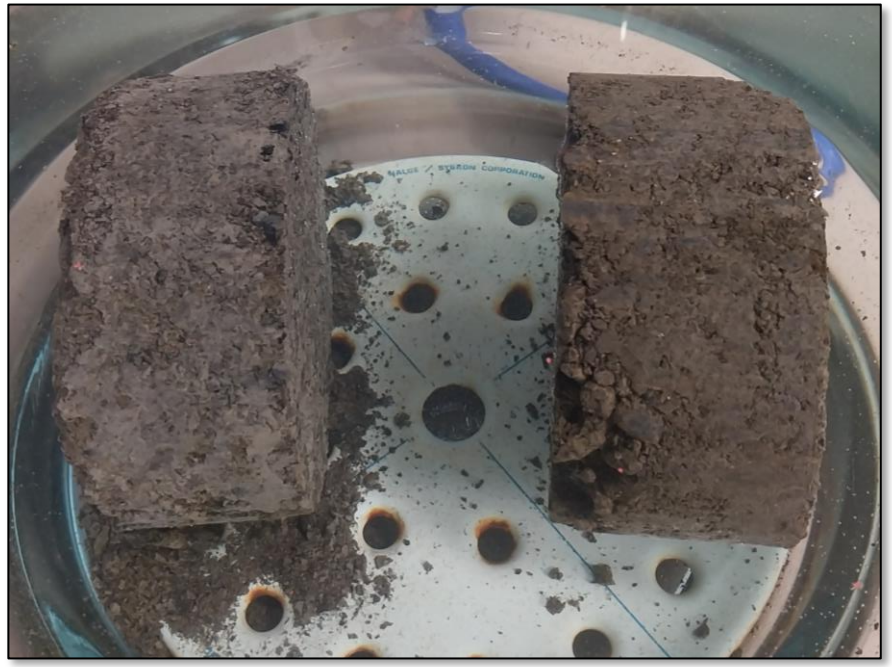
Poured into material and mixed in pug mill

Dispersed throughout material

Iteration 3: Resilient Modulus



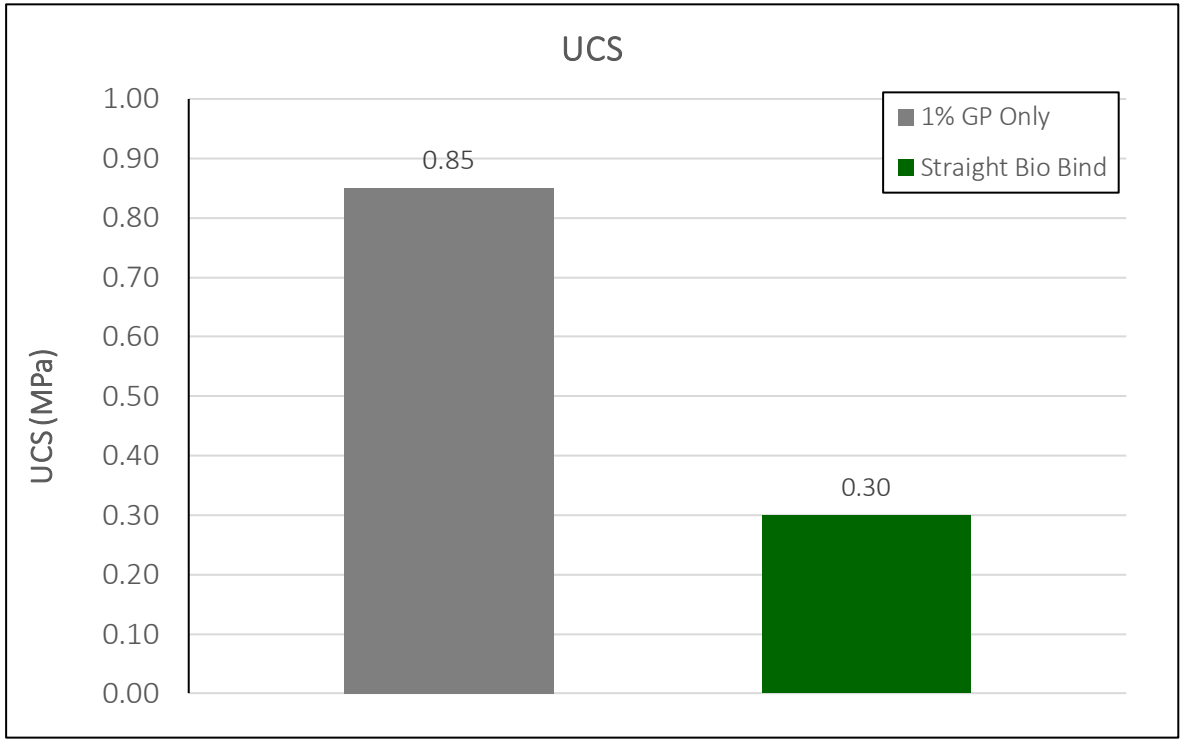
Vacuum Soaking

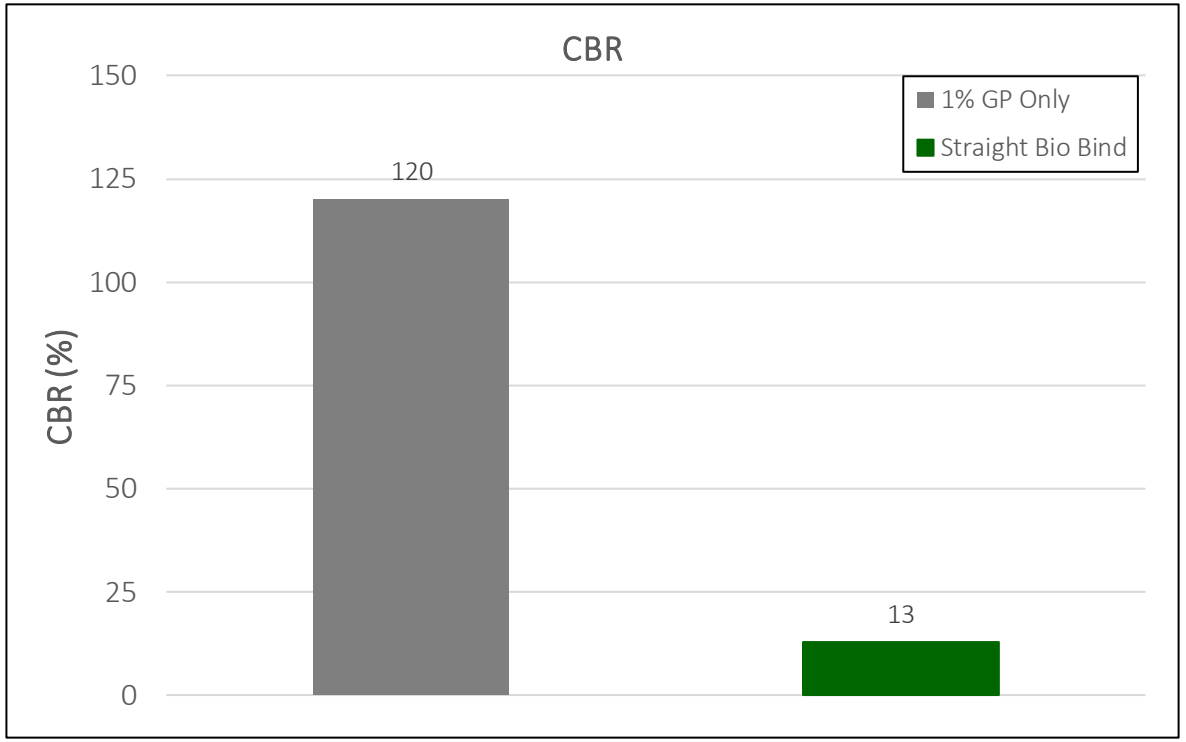


GP only

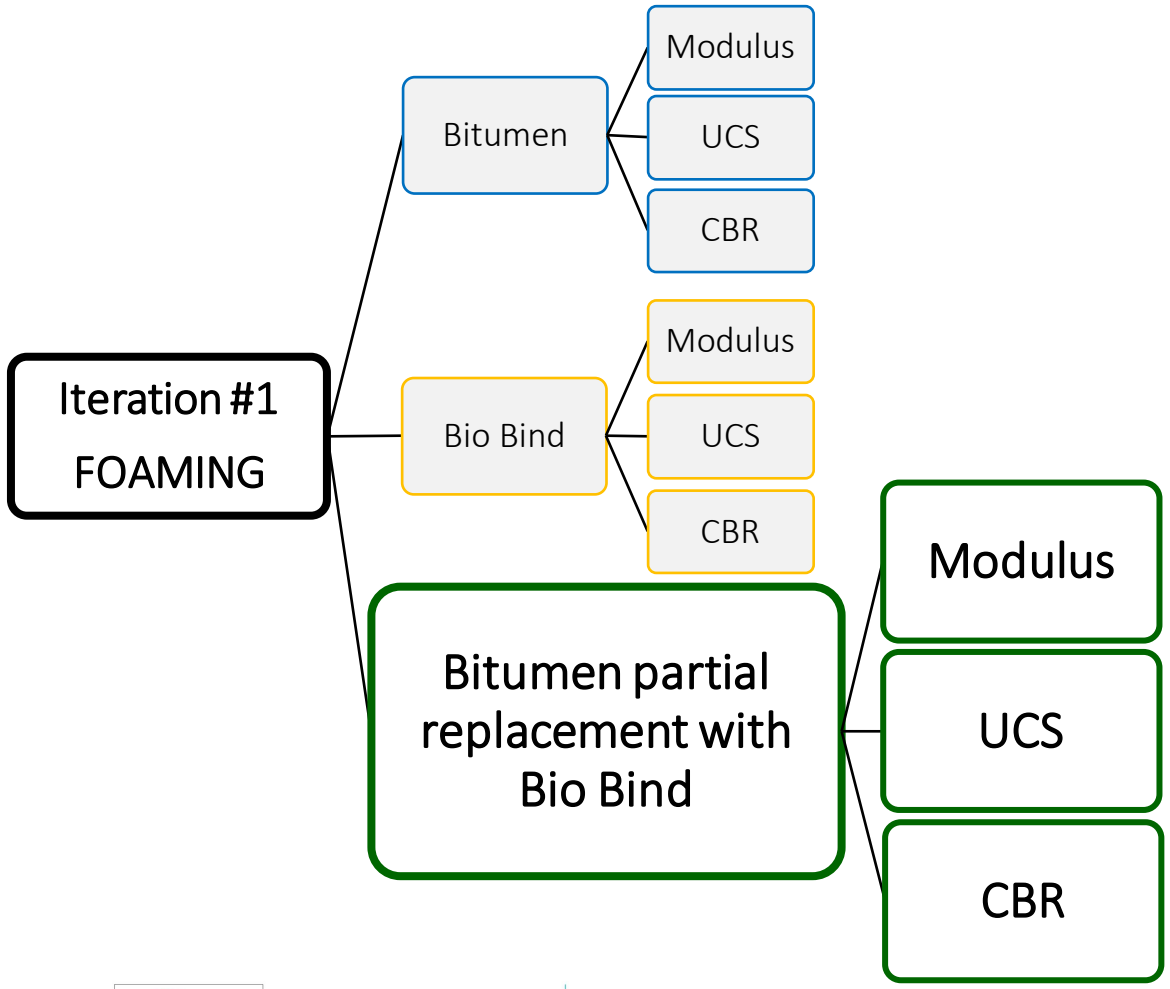
GP + Bio Bind

Iteration 3: UCS & CBR



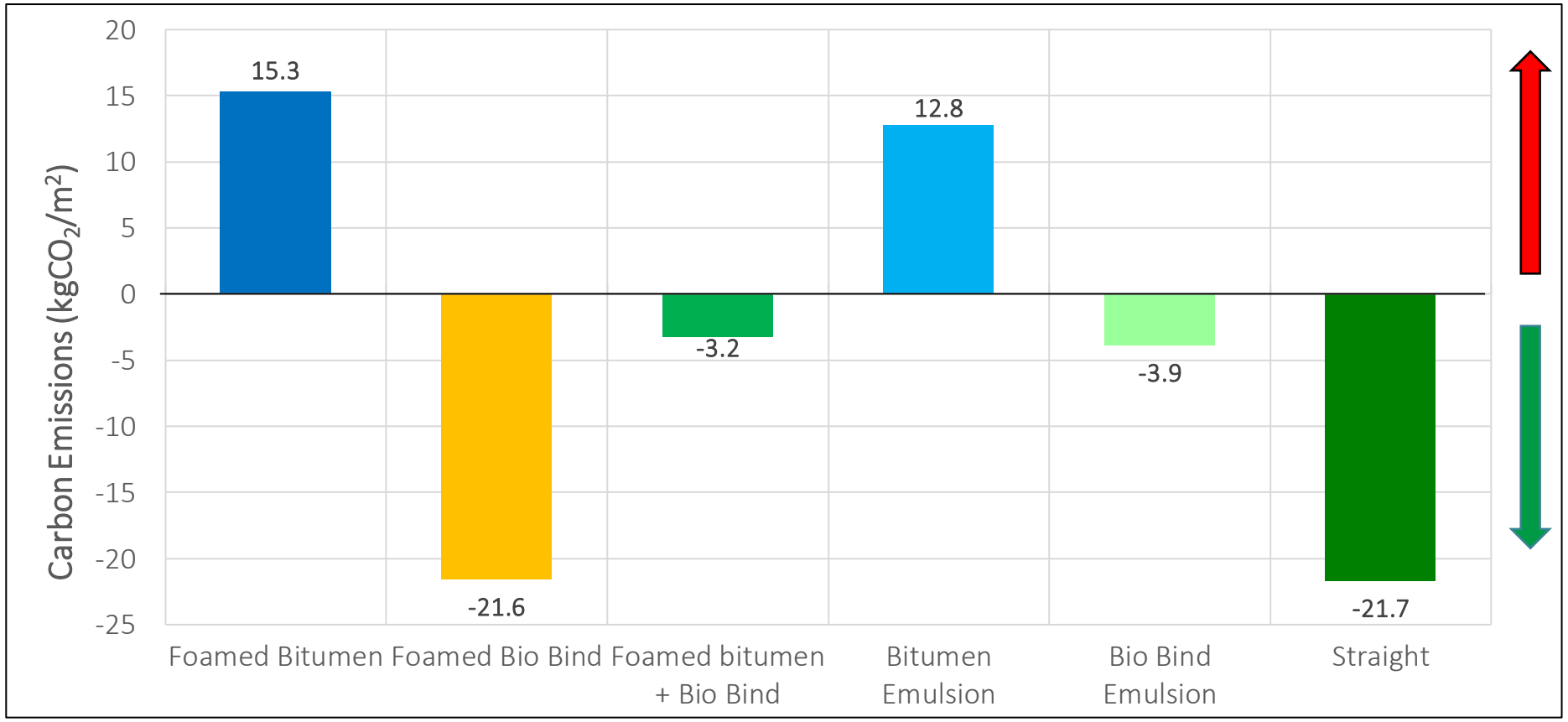


Summary: Highlighted Results



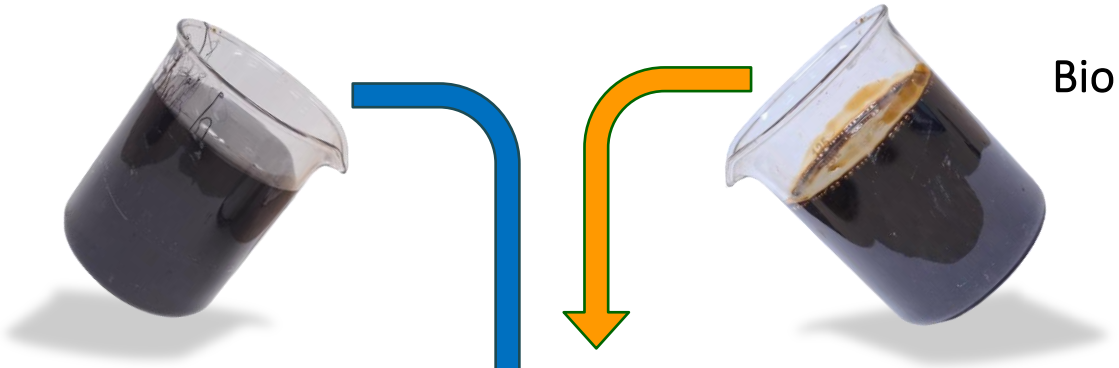
Foamed bitumen partial replacement with Bio Bind	Test Results
3 Day Dry Modulus	3996 MPa
3 Day Soaked Modulus	2868 MPa
UCS	0.55 MPa
CBR	Exceeded Capacity

Summary: CO_2e Emissions Comparison



Factors considered: Material embodied, transport, stabilisation plant, heating

Summary: Further Investigation



Bio Bind

Bitumen

Bitumen partial replacement with Bio Bind

Decarbonisation & climate resilience

REDUCED EMISSIONS

WATER PROOFING

Thank You

Road Science

https://www.roadscience.com.au/

We Are Listeners – We Are Trusted Experts – We Find Solutions