

Noise Mitigation in Passenger Tyres

Group 2 - April 6th, 2023 – Presented by Joost Hubbard & Kwaku Asiedu

Design

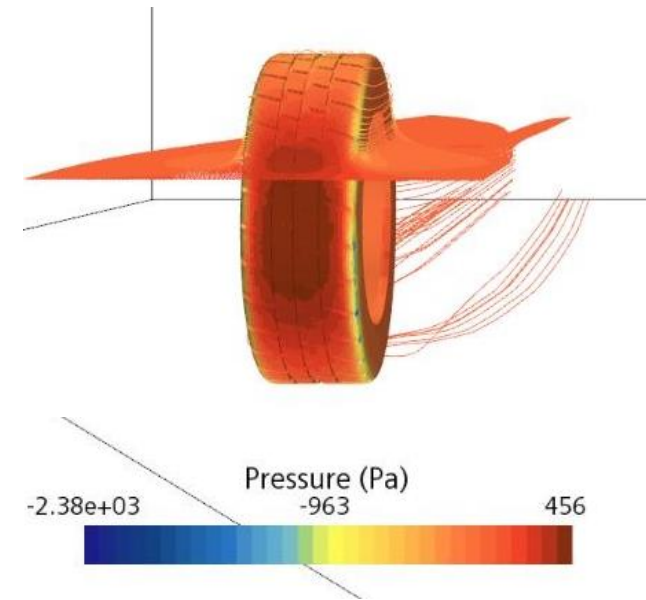
Design specifications to minimise noise:

External

1. **Shallow, symmetrical and non-directional tread.** Minimises external noise, mainly caused by pipe resonance.
2. **Radial cap ply.** Lowers rolling resistance which has been proven to reduce tyre noise by up to 10dB.

Internal

1. **Interior foam,** affixed to the inner liner. Dampens vibrational peaks that occurs at the point of cavity resonance.



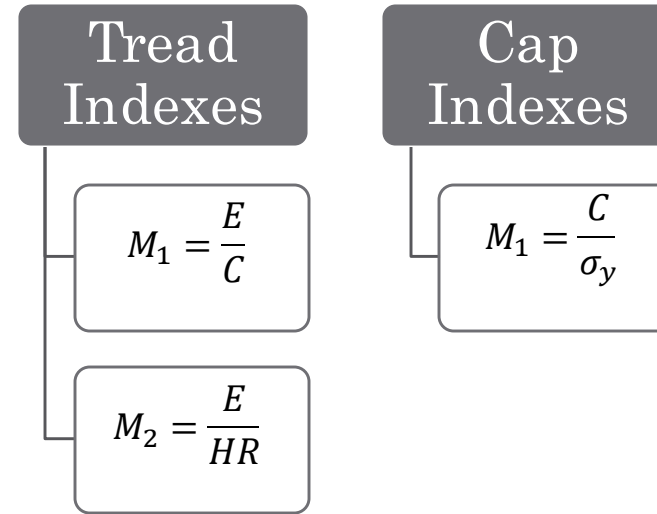
CFD rendering of full tyre and CAD of tyre tread.

Material Assessment

Material assessment was conducted through two methods, material indexes and decision matrices. These were applied where applicable.

Tread	Cap Layer
Minimise rolling resistance	Maintain water resistance
Maximise wear resistance	Maximise wear resistance
Maximise heat resistance	Maximise heat resistance

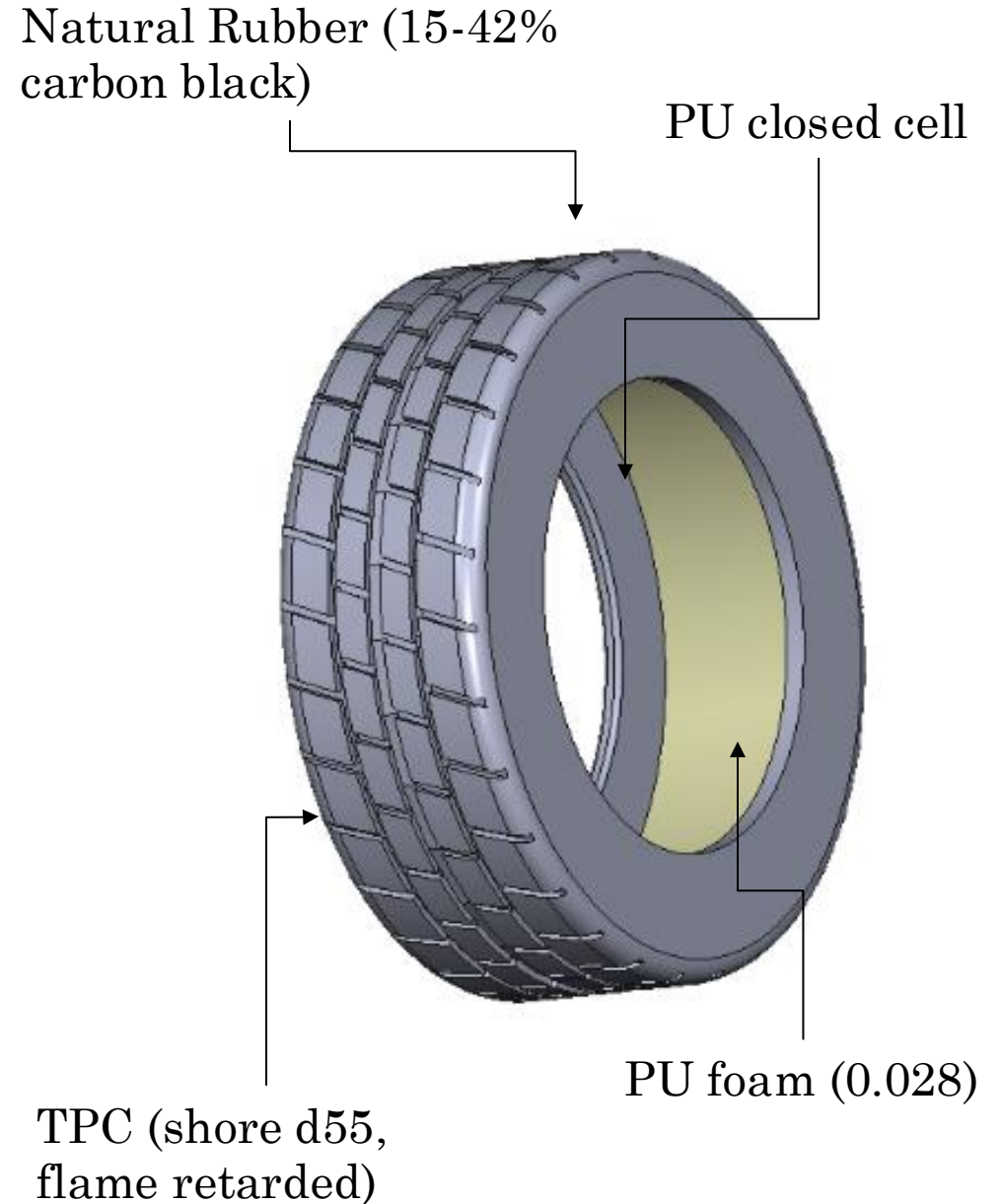
Inner Foam	Inner Liner
Maximise flow resistivity	Minimise density
Optimise density (around 29 kg/m ³ and above)	Minimise cost
Optimise porosity	Maximise elastic modulus
Minimise cost	Maximise compressive stress resistance



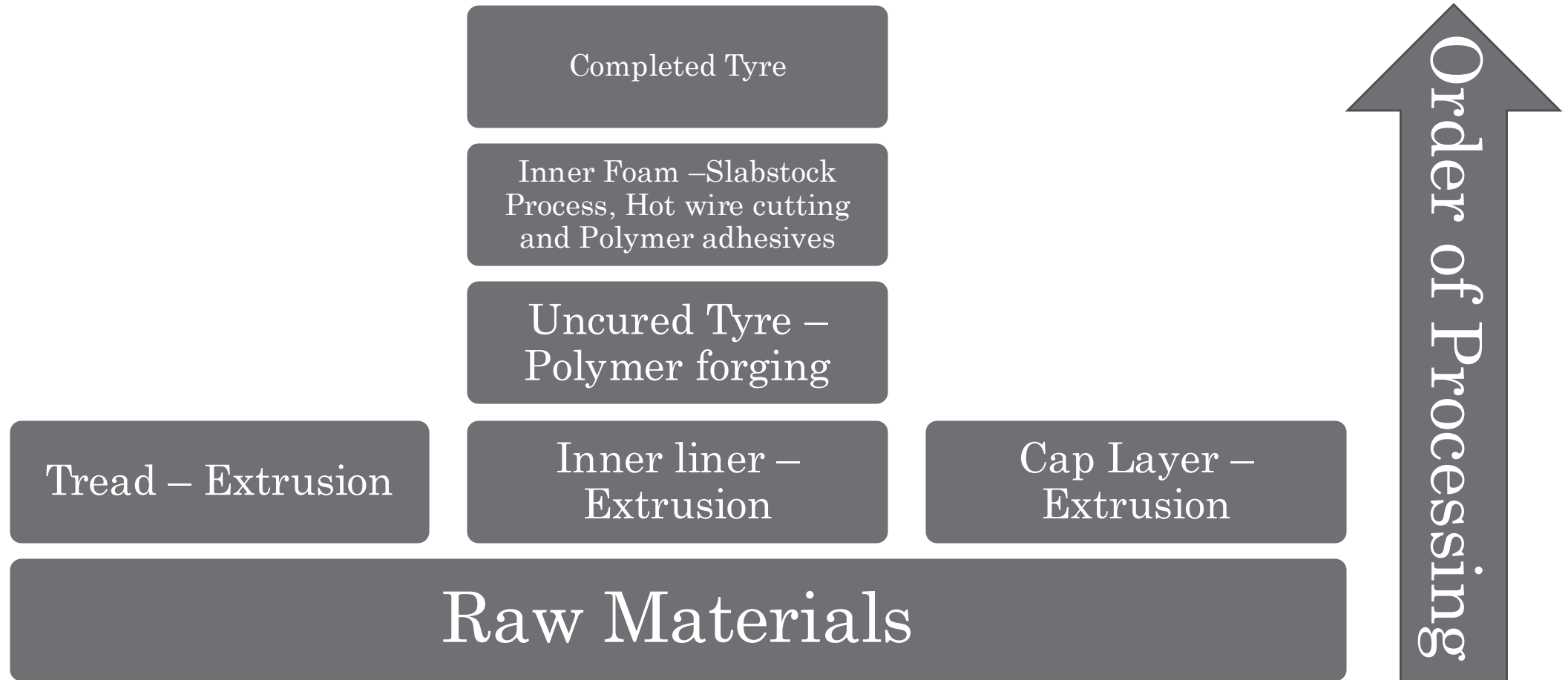
Material Selection

The ideal materials to reduce noise while also retaining the performance of the tyre:

- **Tyre tread** – Natural Rubber (15-42% carbon black)
- **Cap layer** – TPC (shore d55, flame retarded)
- **Inner liner** – PU closed cell
- **Inner foam** – PU foam (0.028)



Material Processing



Performance Review

- **Noise** – Shallow, non-directional symmetrical tread alongside internal foam and chosen ply all mitigate noise effectively. Minimise peaks in cavity and pipe resonance as well as ensuring low rolling resistance.
- **Fuel efficiency** – Low rolling resistance helps with fuel efficiency drastically.
- **Wet grip** – Tread choices causes risk of hydroplaning and limited traction in non-ideal conditions.
- **Wear** – Wear would be adequate, mostly due to the hardness of the tread and yield strength of the ply – preventing frictional wear and possible punctures.
- **Cost** – Total of all components covered in this report totalled would be £25.45. This is far below the cost of other quiet tyres, meaning the cost of the total tyre would still be cheaper than similar market competitors.

Summary

- Both internal and external noise has been addressed.
- Commercial viability has been maintained.
- Fuel efficiency, wear and cost are within acceptable boundaries.
- Further improvements could be made to improve wet grip.
- Further steps towards non-pneumatic tyres could entirely remove the issue of cavity resonance and internal noise.

Thank you for listening!