

**BTAS**

brake and tyres  
analysis system

**EMISSIONS  
ANALYTICS**

# Real-world tyre degradation Particle VOC Analysis Benchmarking database

2023



**BTAS** | brake and tyres  
analysis system

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# Our Belief

When it comes to the pursuit of emissions reduction, we believe in the power of clarity, transparency and integrity. With real-world data we can meet emissions challenges – instilling trust and confidence in our industry partners and public.

It's with our commitment and independence we are able to make a significant contribution toward positive change and to achieve enduring results.

# Introduction

- Founded in 2011
- Headquartered in the UK
- Operations in UK, Germany, USA and South Korea
- Independent testing house specialising in real-world emissions testing
- Over 2,500 vehicles/machines tested across passenger, commercial and off-road
- Largest commercially available database of real-world emissions data
- We work with regulators, OEMs, Tier 1/2 suppliers, fuel and chemical companies, fleets, consumer media
- Chair of EU CEN Workshops 90 and 103





# Real-world tyre wear

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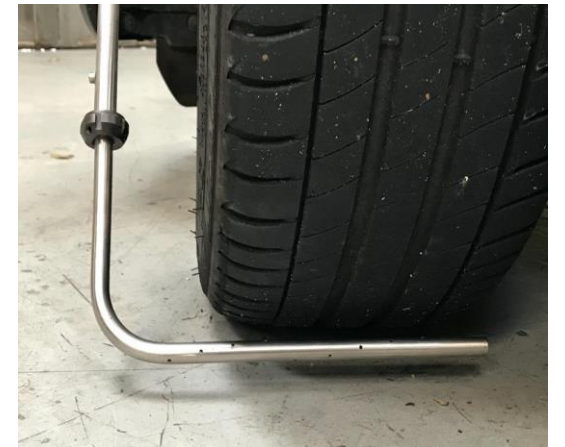
# Real-world Tyre Wear Testing

## Tyre mass loss measurement

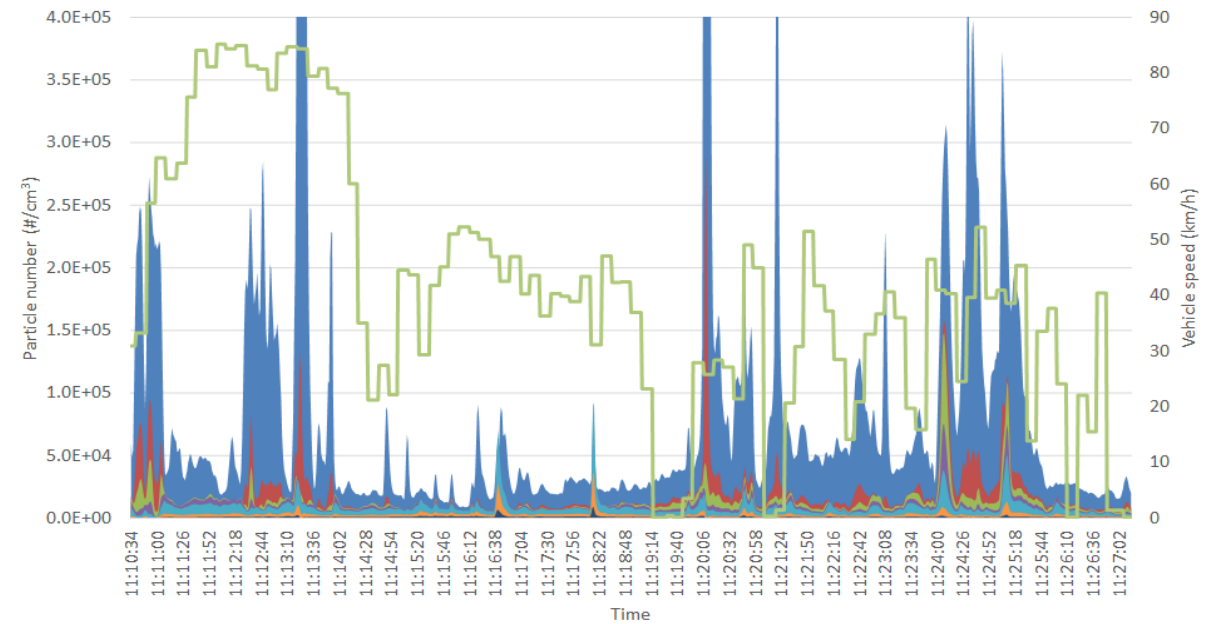
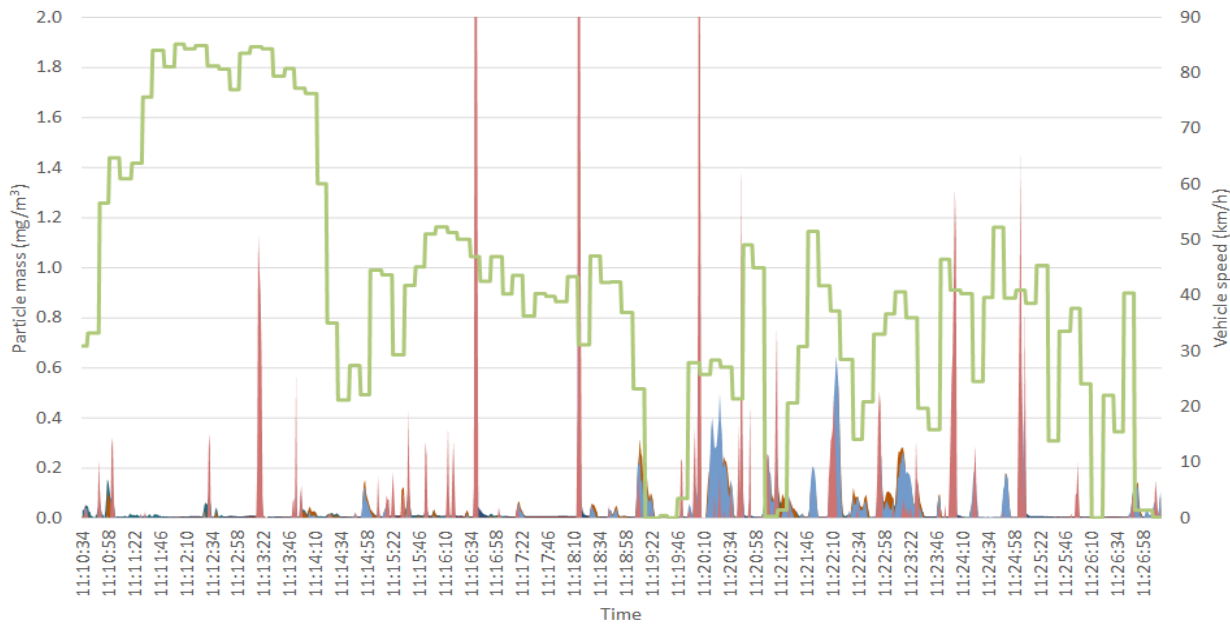
- The basis of the method is to weight all four wheels at the start and end of the test. The tyres remain on the rims throughout. Mass measurement is taken by scales with a minimum resolution of 1g

## Real-time mass and number

- Alongside the mass loss measurement, a real-time signal is collected from a sampling 'scoop' positioned immediately behind on or more tyres
- Measurement of real-time particle size distribution and concentration in the size range of 6 nm – 10  $\mu\text{m}$  at 10 Hz sampling rate



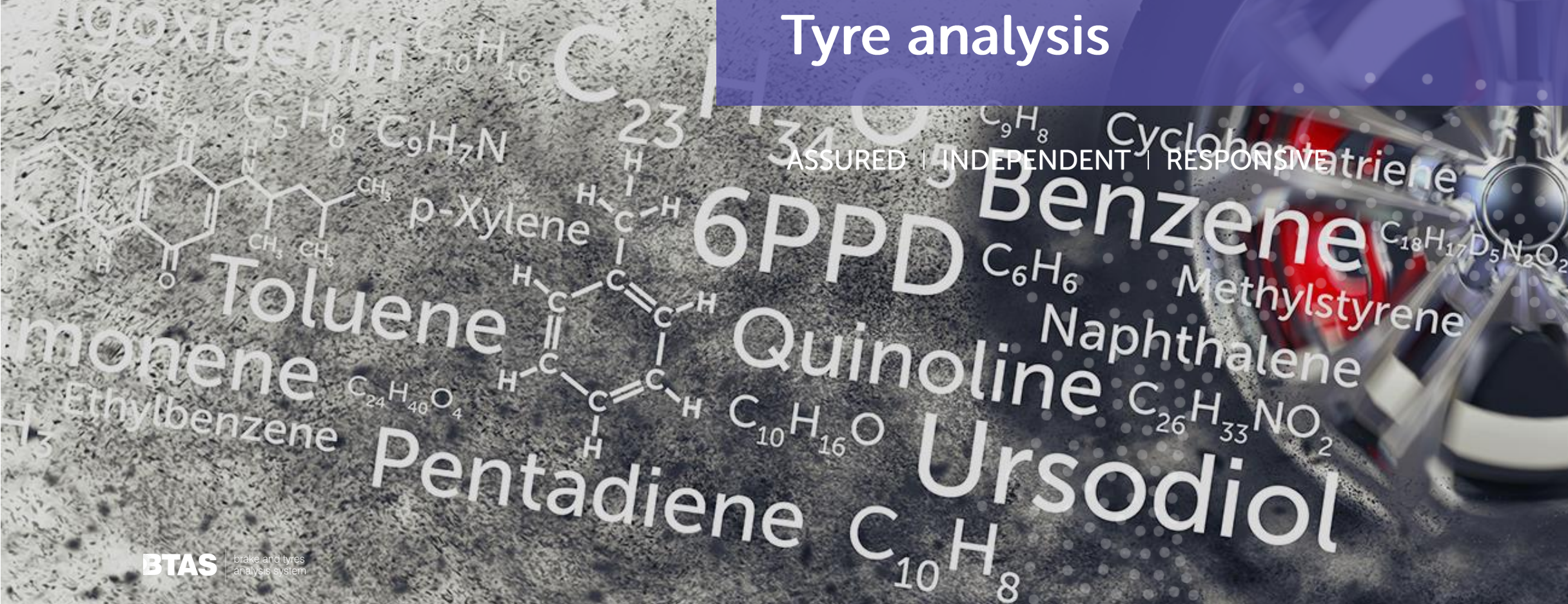
# Particle size distribution





# Tyre analysis

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# Measurements Capabilities



Two-dimensional gas chromatography with mass spectrometry



BENCH-TOF time-of flight mass spectrometer



INSIGHT flow modulator from SepSolve Analytical for separation

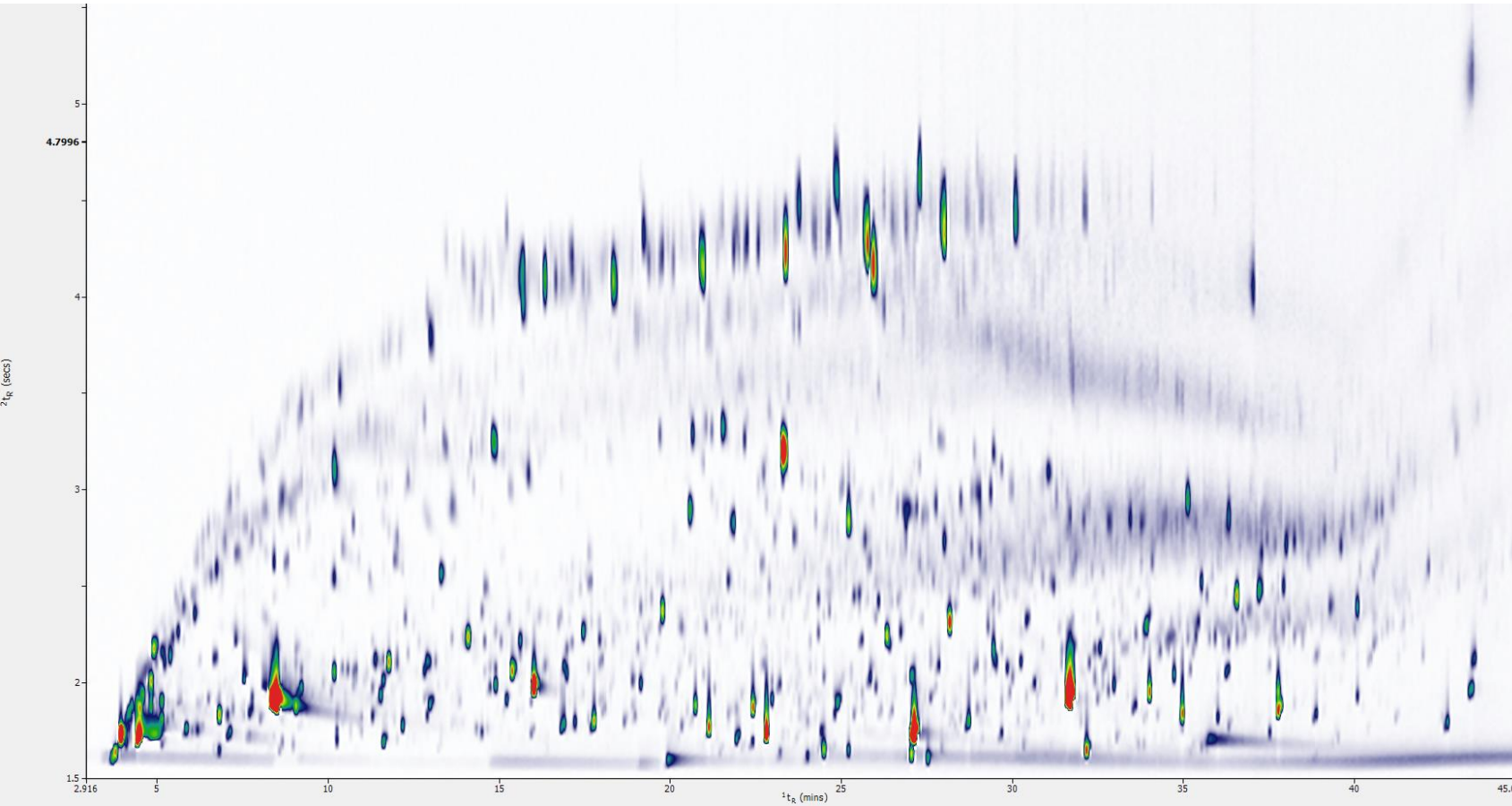


Thermal desorption tube sampling from Markes International



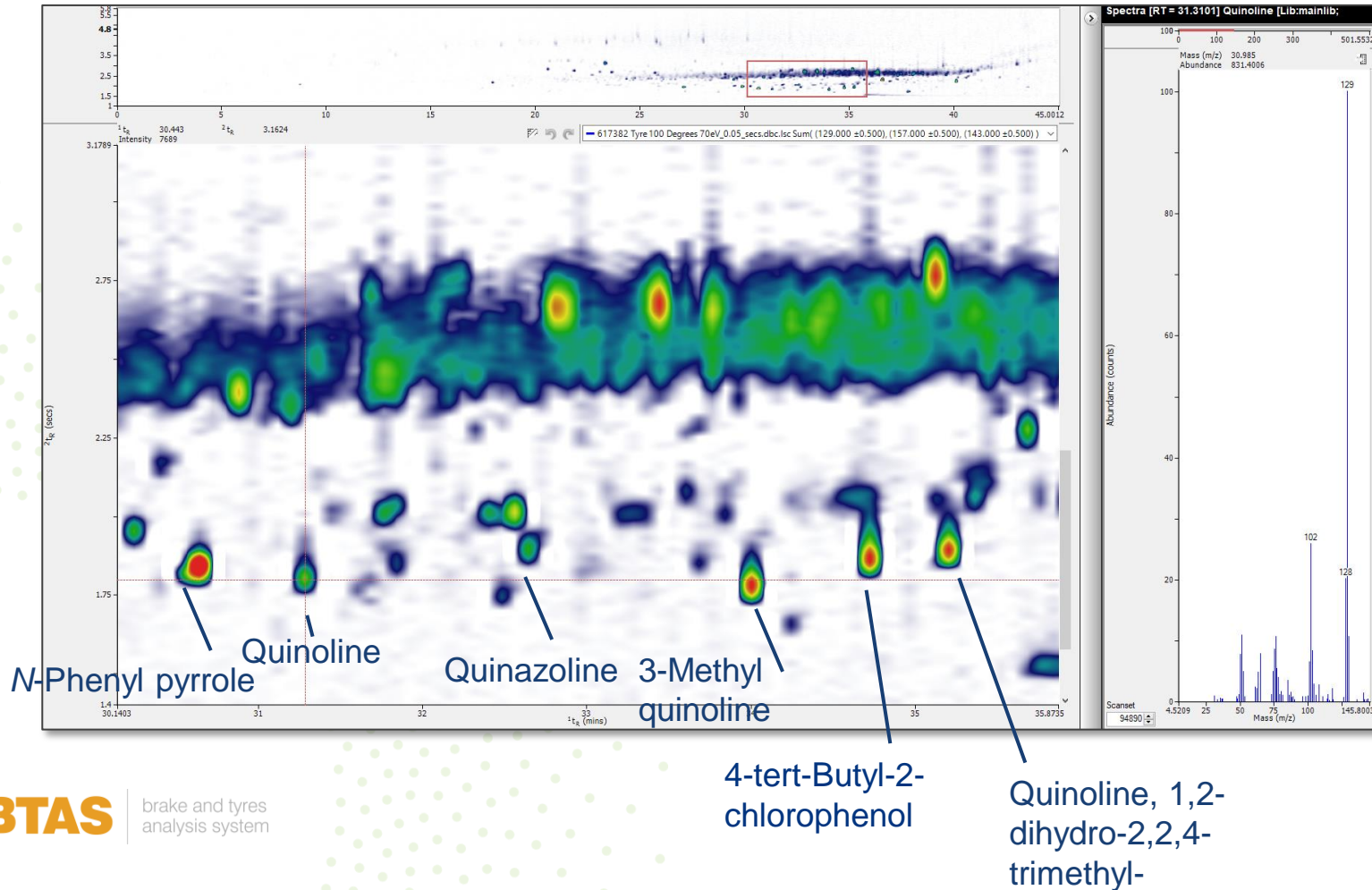


# Off-gassed tyre emissions at 120 °C



- Wide-ranging analytes identified
- Alkanes: lungs, liver, kidney, brain
- Cycloalkanes: headaches, dizziness
- Terpenes: aromas
- Aromatics: carcinogens
- N-containing: carcinogens

# Enhanced separation of chemical classes

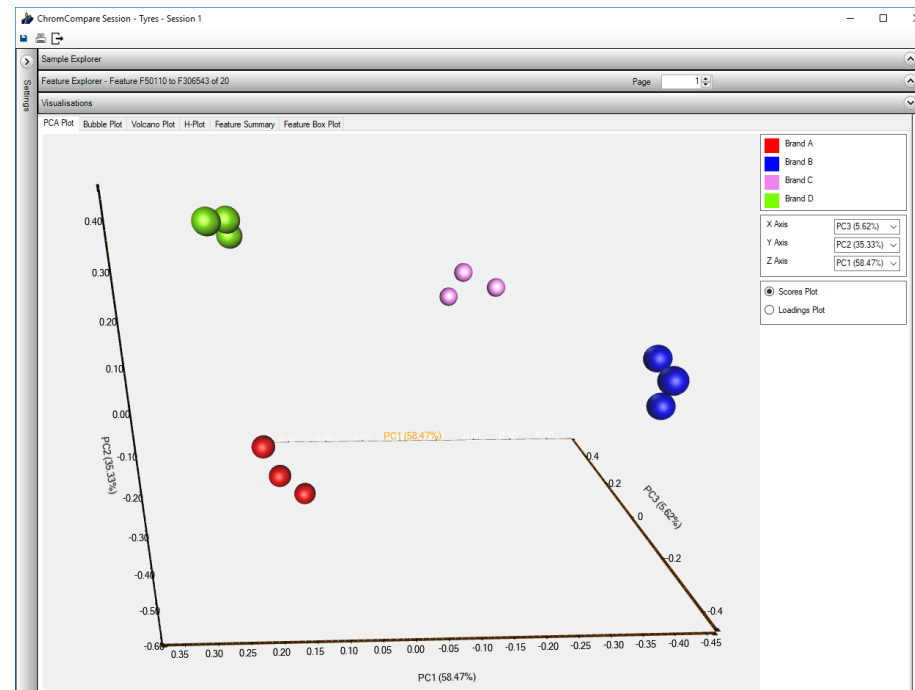
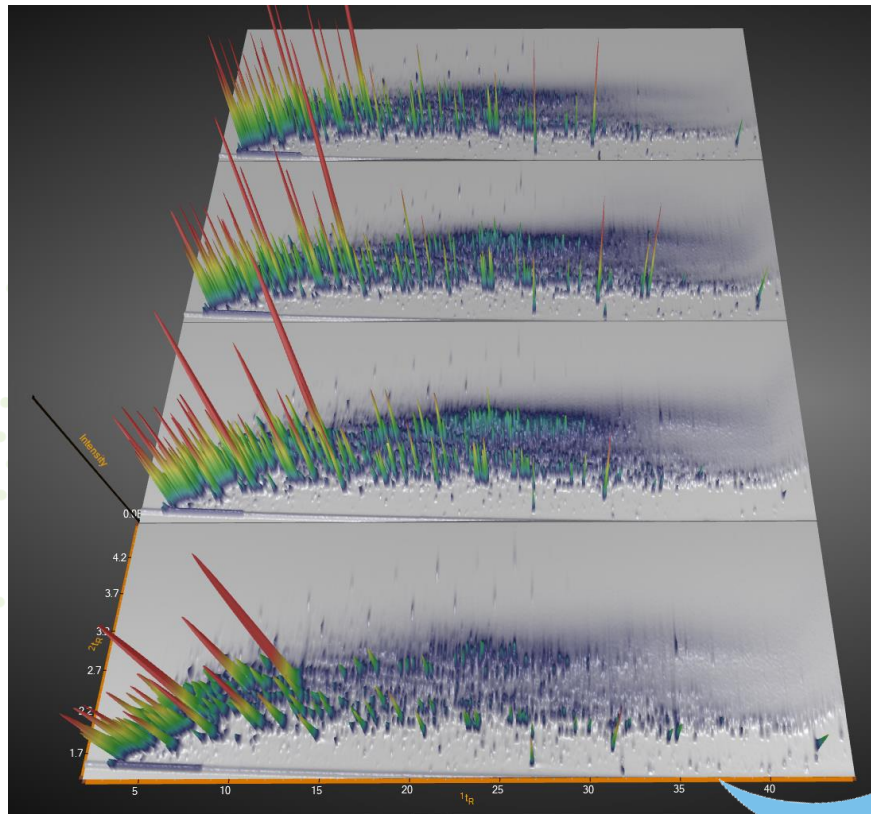


- >70 N-containing compounds identified by screening against NIST database
- Multiple coelutions would have occurred in a 1DGC separation





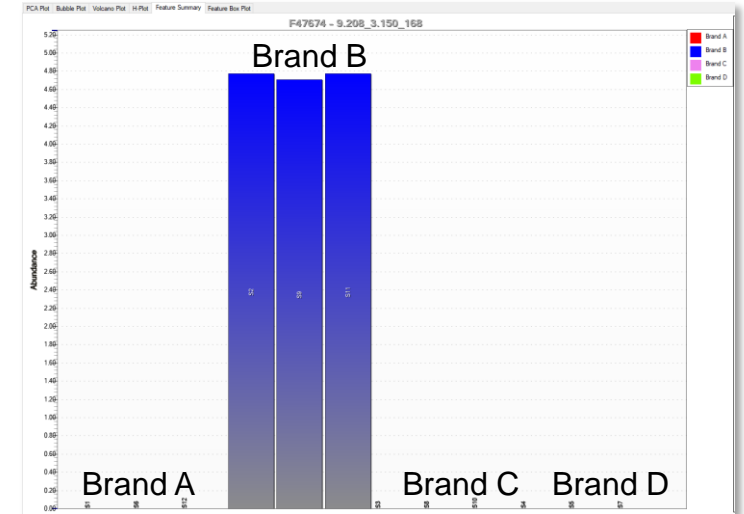
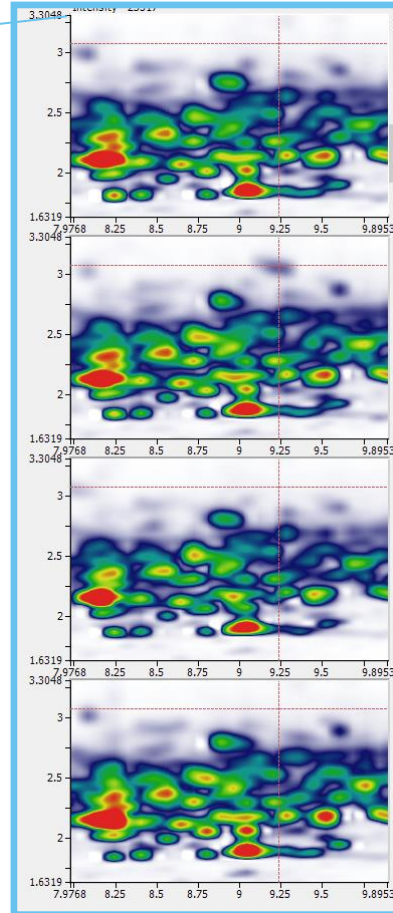
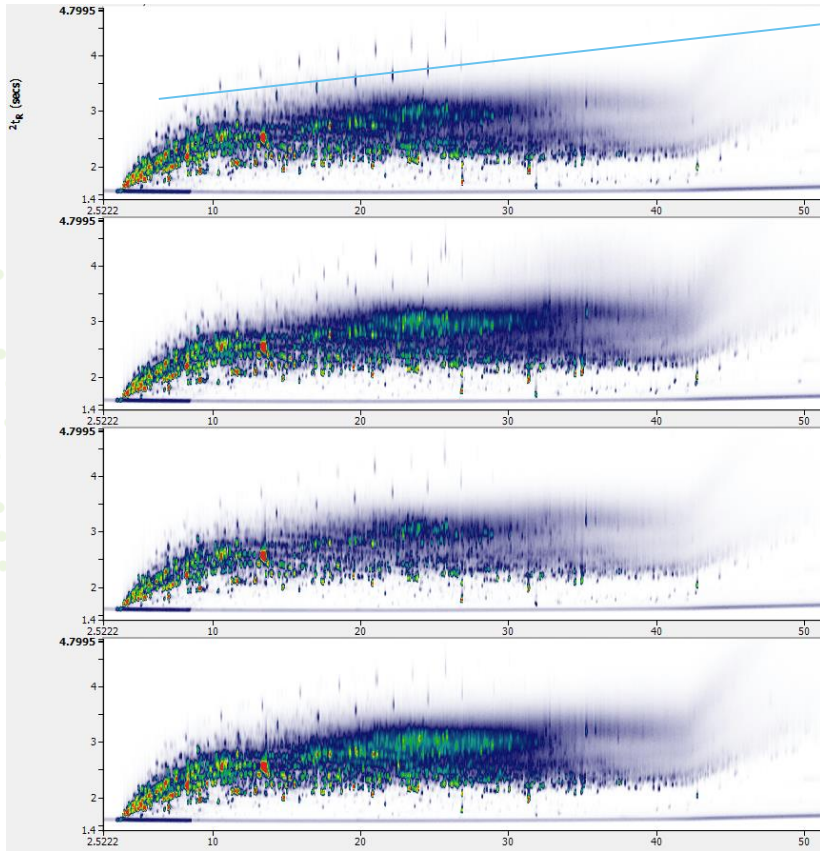
# Comparing tyre compositions



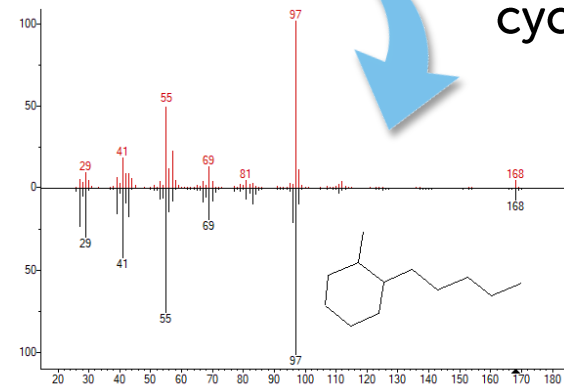
- Using pyrolysis with GCxGC-TOF-MS
- Can be used to differentiate between tyre brands
- Or between tyre and non-tyre organic materials



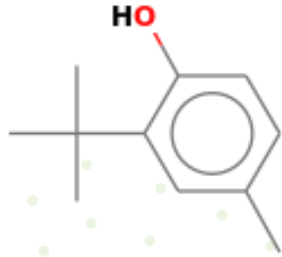
# Differentiators and tracers



= 1-methyl-2-pentyl  
cyclohexane

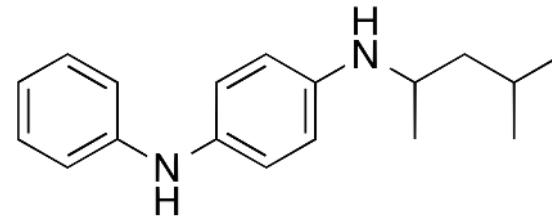


# Notable compounds



Prevalent in some

- phenol, 2-(1,1dimethylethyl)-4-methyl-
- Respiratory irritant, leathery smell



Prevalent to significantly varying degrees

- N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine, aka 6PPD
- Preservative, reacts with ozone in the air
- 6PPD-quinone linked to depleted coho salmon in California



# Toxicity evaluation

Hazard code	Description
H300	Fatal if swallowed
H301	Toxic if swallowed
H302	Harmful if swallowed
H303	May be harmful if swallowed
H304	May be fatal if swallowed and enters airways
H305	May be harmful if swallowed and enters airways

- Globally Harmonized System of Classification and Labelling of Chemicals (GHS) – United Nations' standardised system
- Compounds identified CAS Registry Number, unique identifier assigned by US Chemical Abstracts Service
- European Chemicals Agency database of manufacturer disclosures
- 'Hazard codes' described different effects, from irritants to carcinogens
- Each compound can have multiple hazard codes
- Different manufacturers can make different disclosures

The database enables tyres to be rated in order of relative toxicity based upon compounds present in the tyre (rather than assumed environmental impact).

# Toxicity results

- Over 300 European market tyres now tested
- 410 organic compounds separated on average
- 78 organic compounds identified using NIST library
- 46 hazard codes cited
- Least toxic tyre 85% times less than worst
- Least toxic manufacturer 61% times less than worst

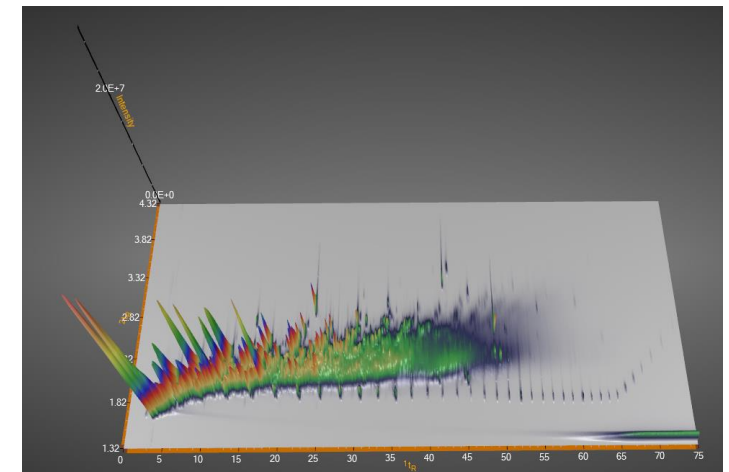
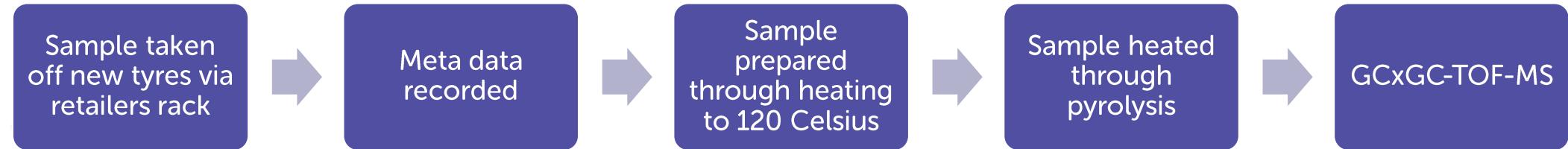
Europe				
#	Manufacturer	Toxicity	MoM	YoY
1	Avon	19		
2	Kormoran*	22		
3	Pirelli	25		
4	Continental	25		
5	Michelin	25		
6	Tegrys*	28		

\*Table for example purposes, not representative





# EQUA Database Test Process



# EQUA Tyres Database

- Tyre samples independently sourced
- Currently >250 tested, access to at least 300 samples per year
- Subscribers can guide future sample collection to manufacturers and models of interest
- The EQUA platform to provide summarised results via corporate access to a cloud based database and raw data upon request
- Specific tyres can be requested and private testing is available
- Database access is per annum with no single user license, up to 25 representatives can gain access



# Conclusion

- What is in our tyres is of growing industry concern, our database answers those questions
- Unique independent R&D and competitive benchmarking tool
- Outstanding compound separation and identification through two-dimensional GC
- Private tyre testing available
- Consultative service, we welcome guidance in terms of tyres of future interest
- This is the first version of the database, it will adapt as we learn how it used



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## Assured

Emissions testing in real-world conditions brings challenges that experience anticipates and expertise overcomes. We deliver.

## Independent

Objectivity and candour are the driving forces in all our work, so you know the facts.

## Responsive

We're fast on our feet so we can conduct emissions testing when and where we're needed.

Thank you.

Contact Us

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