



Condensable Particulate

Keep our Air Shed Clean

What is Condensable Particulate?

Particulate **Solid** when **Cold** - **Gas** when **Hot**

Temperature	Moisture	Particulate	Organic Particulate	Candle Wax
Cold (<0)	Solid	Solid	Solid	Solid
Ambient (0-30)	Liquid	Solid	Liquid and Solid	Solid
Stack (120-200)	Gas	Solid and Gas	Gas	Gas

Condensable at Ambient Temperature

- Changes from a gas to solid as stack gas cools.
- Very fine typically less than $1\text{ }\mu\text{m}$.
- Highly visible. Smoke is a good example.
- Blue smoke is largely condensable
- Referred to as Condensable particulate matter (CPM).





Condensable – Blue Smoke

- Cigarette smoke is blue – very small particles
- When exhaled it is white – large particles

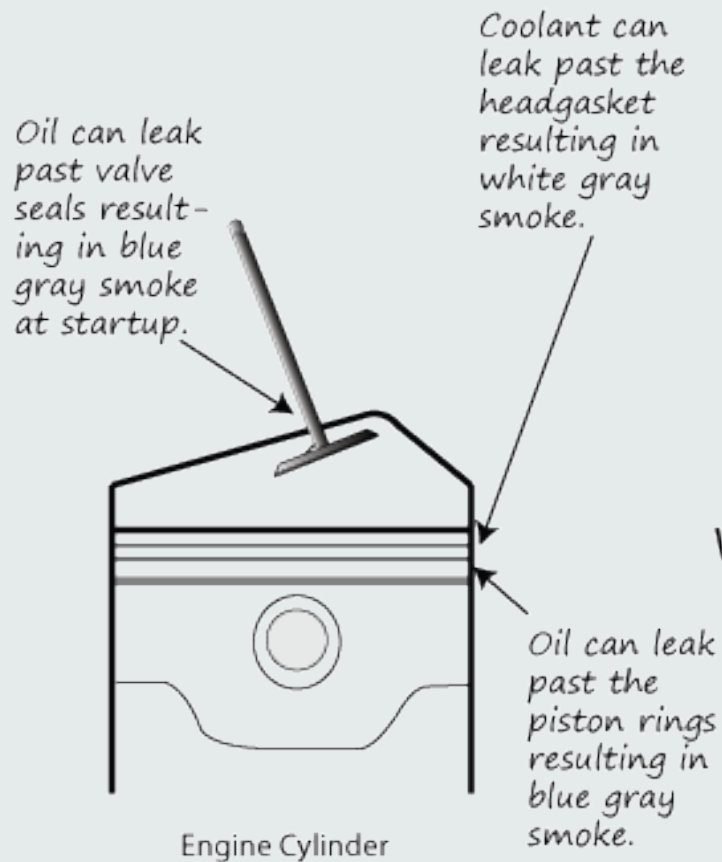
Why White

- Particles change in size – become bigger
- Many remain in lungs till biopsy

Why Blue

- Small particles deflect the light
- Blue wavelength similar to the particles ($0.45 - 0.5 \mu\text{m}$)





Blue gray smoke caused by oil.

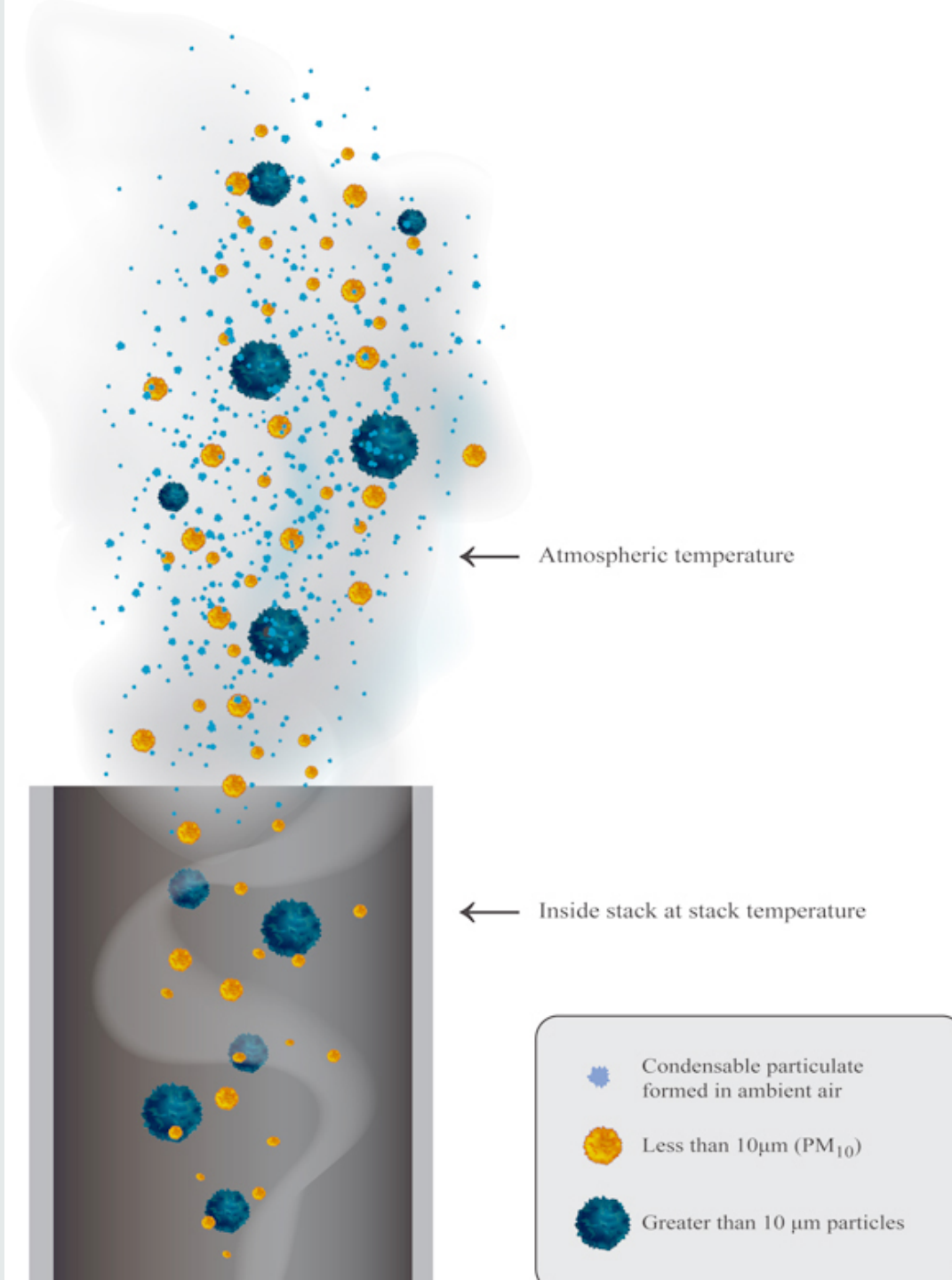


White gray smoke caused by a leaking headgasket.



Black smoke caused by a rich fuel mixture.



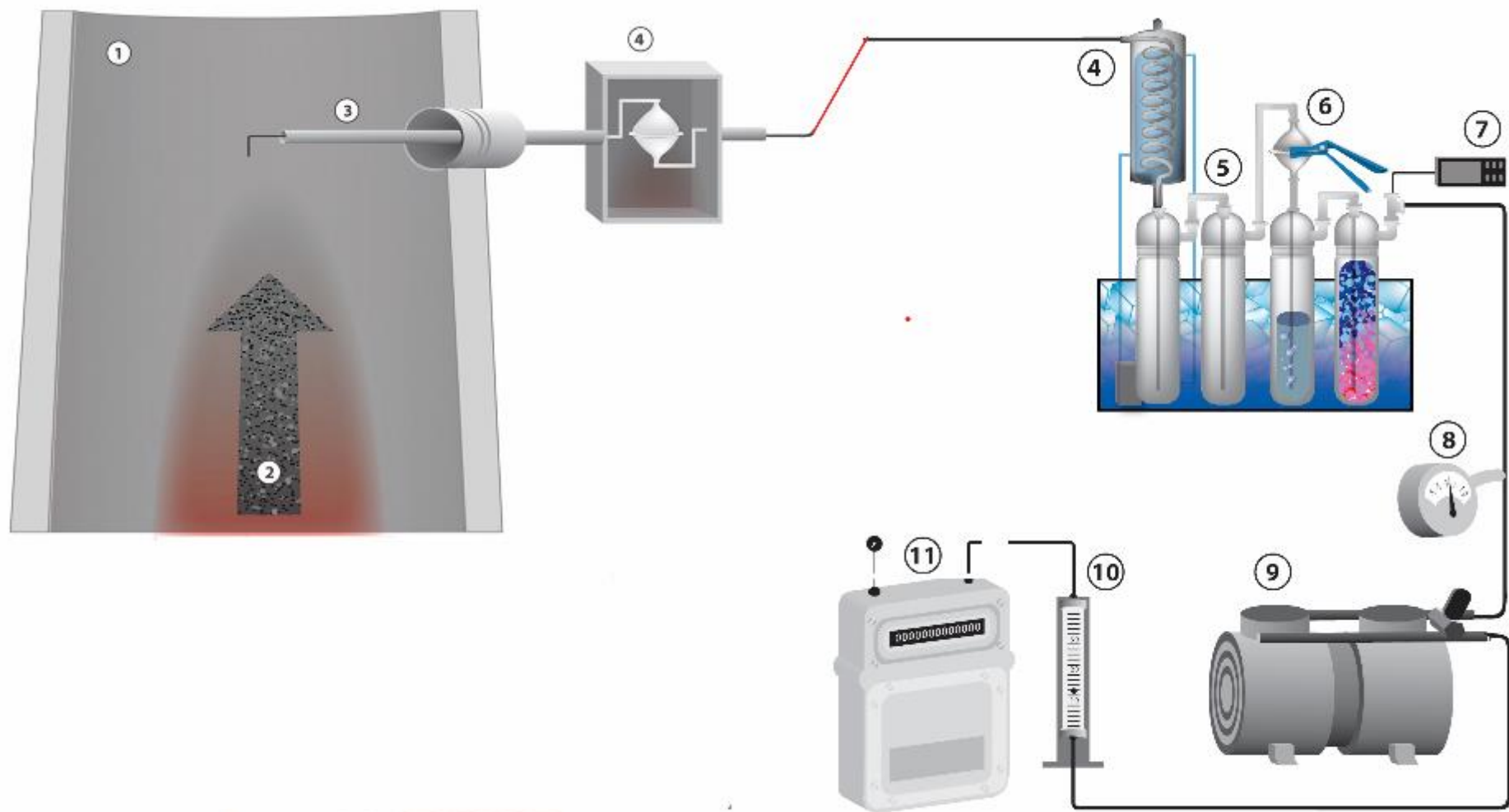


What is Total Particulate

Condensable Particulate + **Filterable Particulate** = **Total Particulate**

Condensable – Solid at ambient temperature

Filterable – Solid at Stack Temperature









About Condensable Particulate

- 90% is less than PM₁
- A lot of organics - oils
- High health risk – very small so penetrates deep into a persons lungs
- Air pollution – listed as a known carcinogen
- Stable in air – collected on ambient samplers.

Baghouses

- On boilers must be heated to above 100 C
- If not heated bags very quickly get blocked
- If not heated condensable particulate will form and be trapped.

Stack One – Wood Fired Boiler

- Wood fired boiler
- Baghouse
- Filterable particulate (at stack temperature) = 9.6mg/m^3
- Condensable particulate (ambient temperature) = 280mg/m^3
- Ratio = 97% condensable, 3% Filterable

The baghouse removes the filterable particulate (solid at 200 c) but lets the condensable particulate through. Consent condition required less than 20 mg/m^3 **total** particulate.

Stack Two – Print Press Ovens

- Printing Press
- Ovens
- Filterable particulate (at stack temperature) = 13mg/m^3
- Condensable particulate (ambient temperature) = 180mg/m^3
- Ratio = 93% condensable, 7% Filterable

Stack Three – Hot mix plant

- Hot mix plant
- Filterable particulate (at stack temperature) = 26mg/m^3
- Condensable particulate (ambient temperature) = 280mg/m^3
- Ratio = 92% condensable, 8% Filterable

Stack Four – Coal Fired Boiler

- Coal Fired boiler
- Filterable particulate (at stack temperature) = 61mg/m^3
- Condensable particulate (ambient temperature) = 67mg/m^3
- Ratio = 52% condensable, 48% Filterable

Summary

Measured reported – Not measured Reported

Stack	Stack (mg/m ³)	Condensable (mg/m ³)	In Stack %	Condensable %
1	9.6	280	3	97
2	13	180	7	93
3	26	280	8	92
4	61	67	48	52
Wood Fire	47	130	26	74

National Environmental Standard

Stack Testing – measure small amount particles

Ambient Analysers – measures all particles

- Measured with Ambient analysers – determines all particulate
- Vehicle Emissions – Condensable particulate included in test data
- Wood Burners – condensable particulate included in test data
- Stacks – does not include condensable particulate

Data used in ECAN'S Emissions Inventory's

If condensable emissions not measured industrial data is inaccurate. Excerpt from ECANS emission inventory.

6. Industrial emissions. The most recent complete inventory of industrial emissions is for 2009. An updated estimate of industrial emission was obtained by writing to the 64 sites which collectively emit an estimated 94% of the PM₁₀ emitted by industry in Christchurch. This indicated an overall reduction in industrial emissions from 720 kg/day in 2009 to 590 kg/day in 2014.

<http://ecan.govt.nz/publications/Reports/air-qual-report-chc-airshed.pdf>

Why Measure?

- Reflects what is discharged to the air shed.
- Promotes industry to use technology that will reduce emissions.
 - NZ Foam Latex – Low total emissions
- Stop using baghouses to clean up discharges.
- Promote industry to design burners that burn condensables
- Help clean up the Christchurch air shed
- More accurate emission inventory's
- More accurate models

Other Councils

- Otago Regional Council has a requirement in consents to measure condensable

Consultants

- It is well known by a number of air quality consultants such as
 - Jenny Simpson?, John Iseli, Roger Cudmore, Emily Wilton, Andrew Curtis, Tim Mallet + many more.
- Understand it is part of the discharges.
- Not all know baghouses wont solve particulate discharge problem.
- Very few ask for data to be gathered.
- One has quoted “elephant in the room”
- Emily Wilton prepared emission factors 2008, “Condensable particulate may be an important issue especially in particulate limited air sheds where boiler emission controls, such as bag filters are required.

“<https://www.niwa.co.nz/sites/niwa.co.nz/files/5%20-%20Industrial%20Boilers%20Emissions%20Factors%20in%20NZ%20part%20two.pdf>”

Testing for Condensable

- ECAN incorrectly said that Stuart Keer-Keer only provider of service.
 - Implication doing for business purposes
 - Did not research their comments.
- Currently at least two accredited suppliers in New Zealand
- Currently at least two suppliers (one accredited) in Christchurch
- Currently at least four suppliers or potential suppliers in New Zealand
- Asbestos at earthquake two suppliers of analysis now 10 +