Newly Developed Apparatus for Acoustic Agglomeration Research

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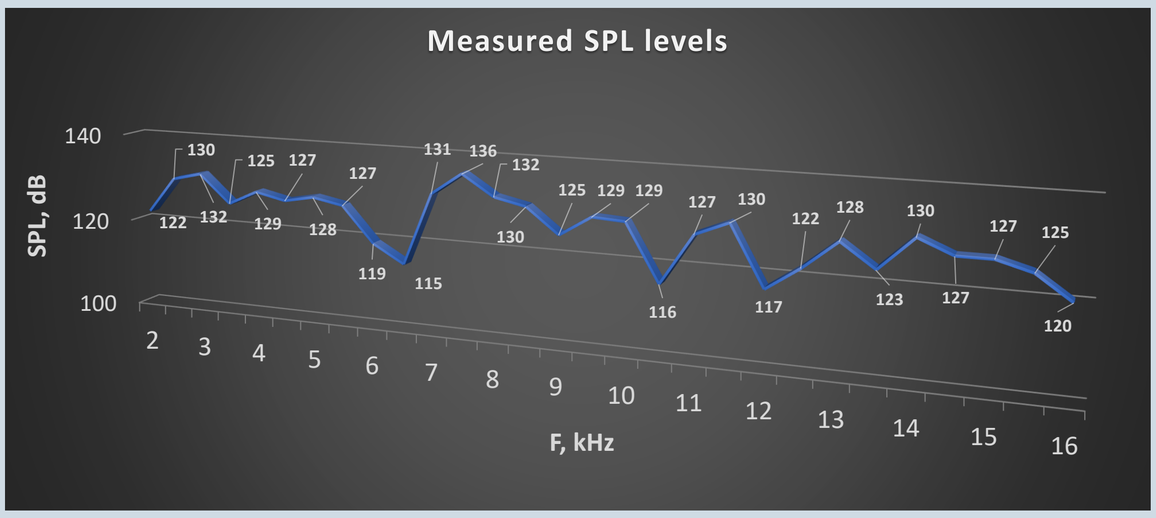
Acoustic agglomeration could be the future of particulate matter pre-treatment technology

– Air pollution is one of the most critical environmental and health issues. Aerosol pollution with fine or ultrafine particulate matter could come from anthropogenic or natural sources.

– With traditional methods like cyclone separators, HEPA filter and electrostatic precipitators not being enough for today's high environmental regulations. A pre-treatment solution like acoustic agglomeration could improve traditional air cleaning methods.

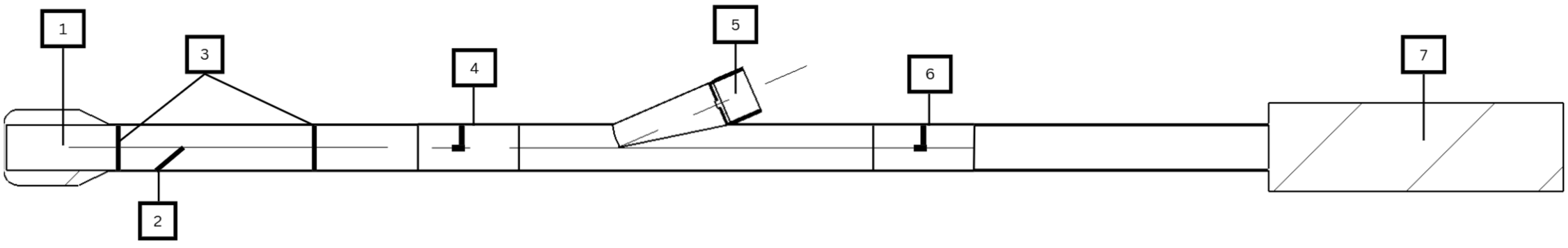
– Acoustic agglomeration is high intensity acoustic waves that force air born particles to collide and make new larger agglomerates. Acoustic waves must reach high sound pressure levels (SPL) and sufficiently high frequencies to effectively induce the agglomeration mechanism.



Experimental setup

Acoustic agglomeration relies on orthokinetic interactions and the acoustic wake effect, where high-intensity sound waves drive particles together. Collisions form larger aggregates that are more easily captured by conventional separation methods.

An acoustic chamber was developed using a 5 m long, 150 mm diameter air duct and a high-intensity compression driver oriented at 150° to the airflow. Air velocity was 1 m/s, with a particle dosing rate of $1.63 \cdot 10^{-4}$ g/s.



Experimental setup schematics. 1 – fan, 2 – particles dispenser with nozzle, 3 – airflow stabilizers, 4, 6 – velocity and particle distribution measuring points, 5 – speaker, 7 – vent camera

Result

With tested frequencies (3 kHz, 7.5 kHz and 14 kHz), the best acoustic agglomeration performance was reached at 14 kHz frequency, with 5 % decrease in smaller size particles and 8 % increase in larger size particles. This shows that acoustic agglomeration needs high frequency waves and high SPL levels.

At lower frequencies it could be seen that there is an increase in smaller size particles number and decrease in larger size particles. This shows us that a opposite mechanism is happening - acoustic deagglomeration.