

# Particle emission from various candle types



Peter Bøgh Pedersen<sup>1\*</sup> and Thomas Nørregaard Jensen<sup>1</sup>

<sup>1</sup>Danish Technological Institute, Kongsvang Allé 29, DK-8000 Aarhus C, Denmark

\*Corresponding author [pbbp@dti.dk](mailto:pbbp@dti.dk)

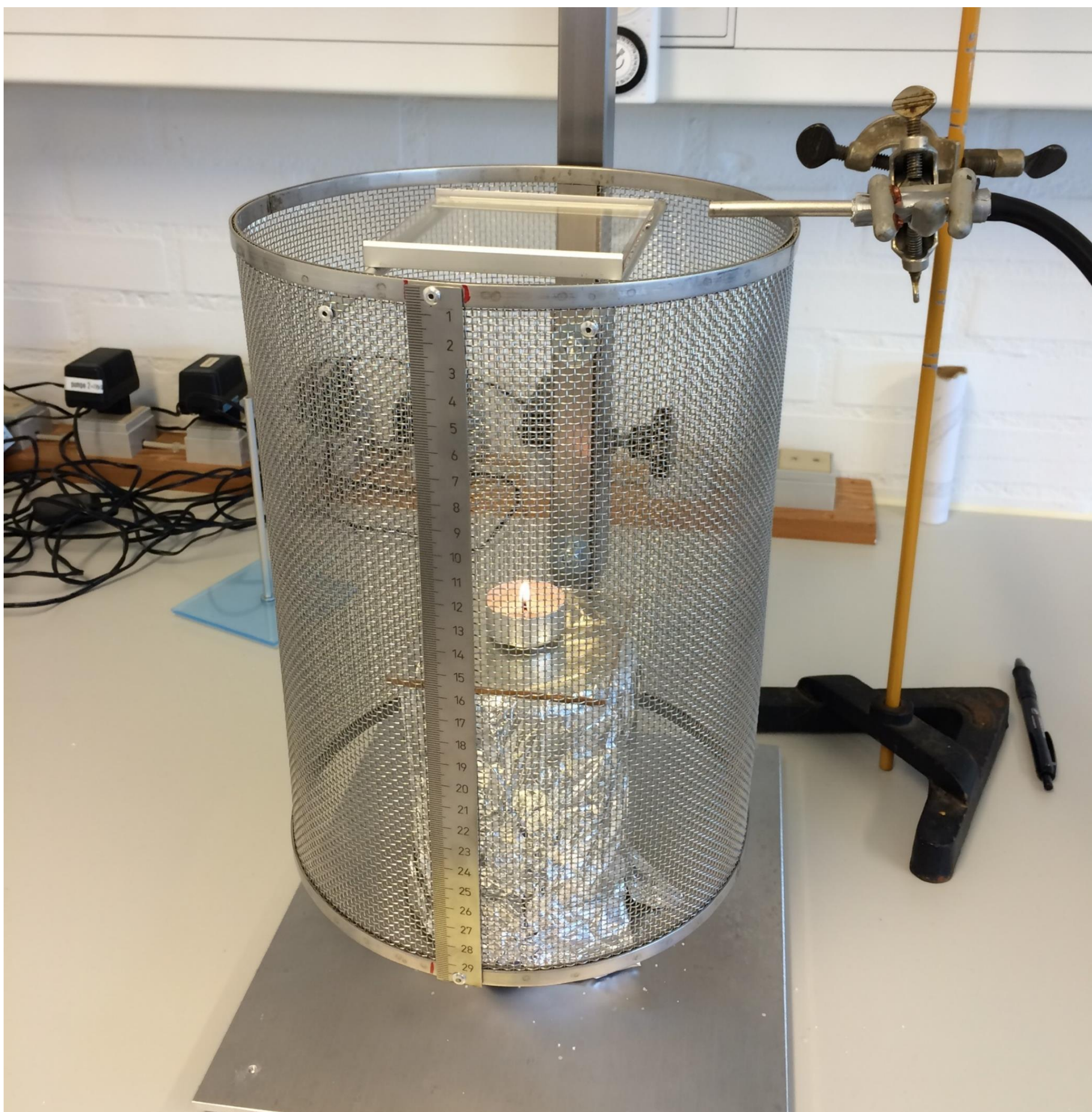


## Introduction

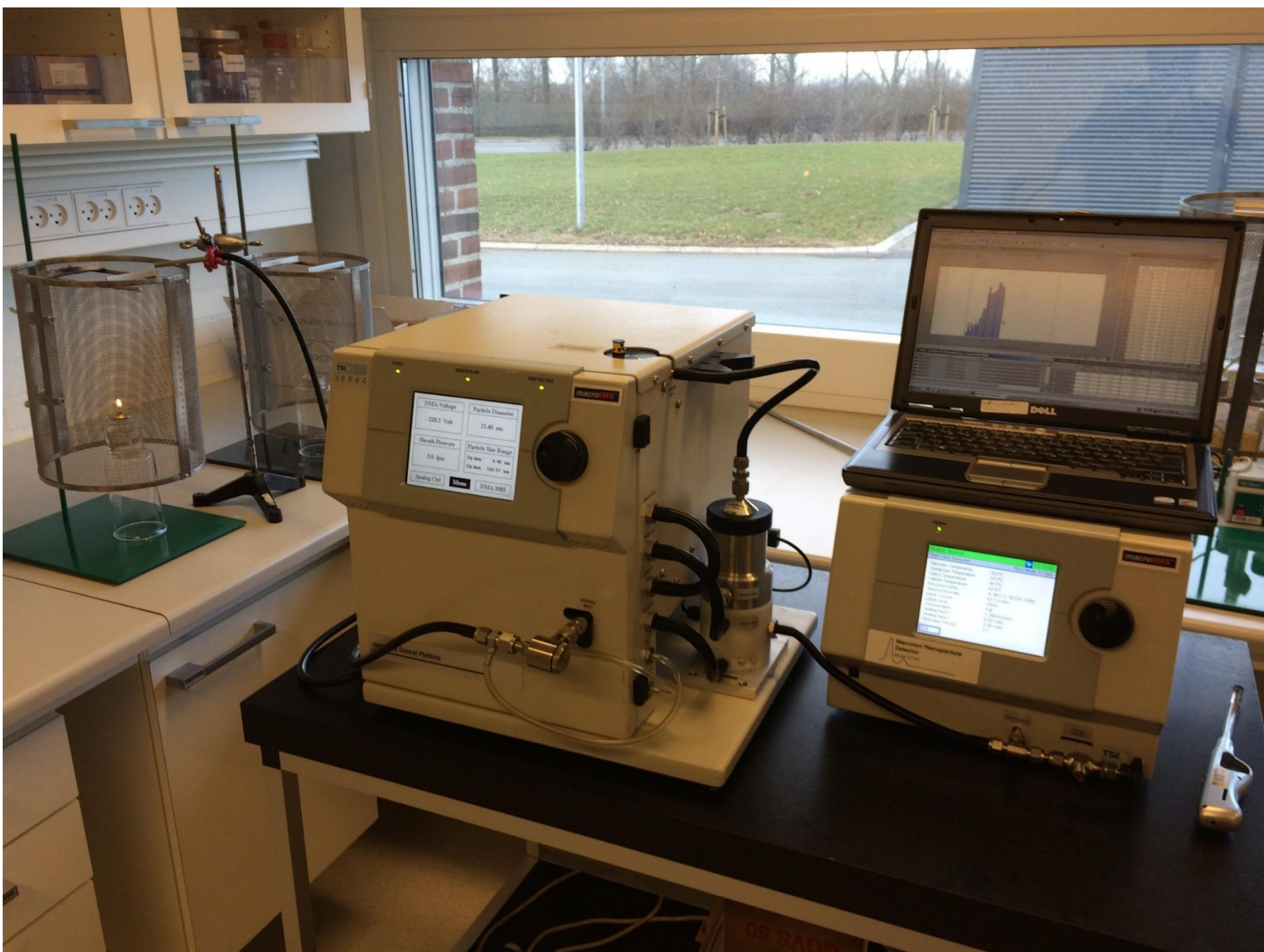
All sorts of candles are being used in widely different situations and locations all over the world. New types of candles see the light of day every year, such as candles made of beeswax, mixes of traditional candle waxes and paraffin, vegetable waxes, animal fat based waxes and others.

## Demand for measurements

The growing awareness regarding particle emissions from various sources is increasing, demanding additional information and knowledge. In a study, particle emissions in 56 Danish homes were measured, and it was found, that in the homes where candles were used, candles were responsible for approx. 60 % of the residential integrated exposure [1]. This has resulted in an increasing demand for measurements on particle emissions from various candle types, such as square candles, tealight candles, candlestick candles and oil lamps.

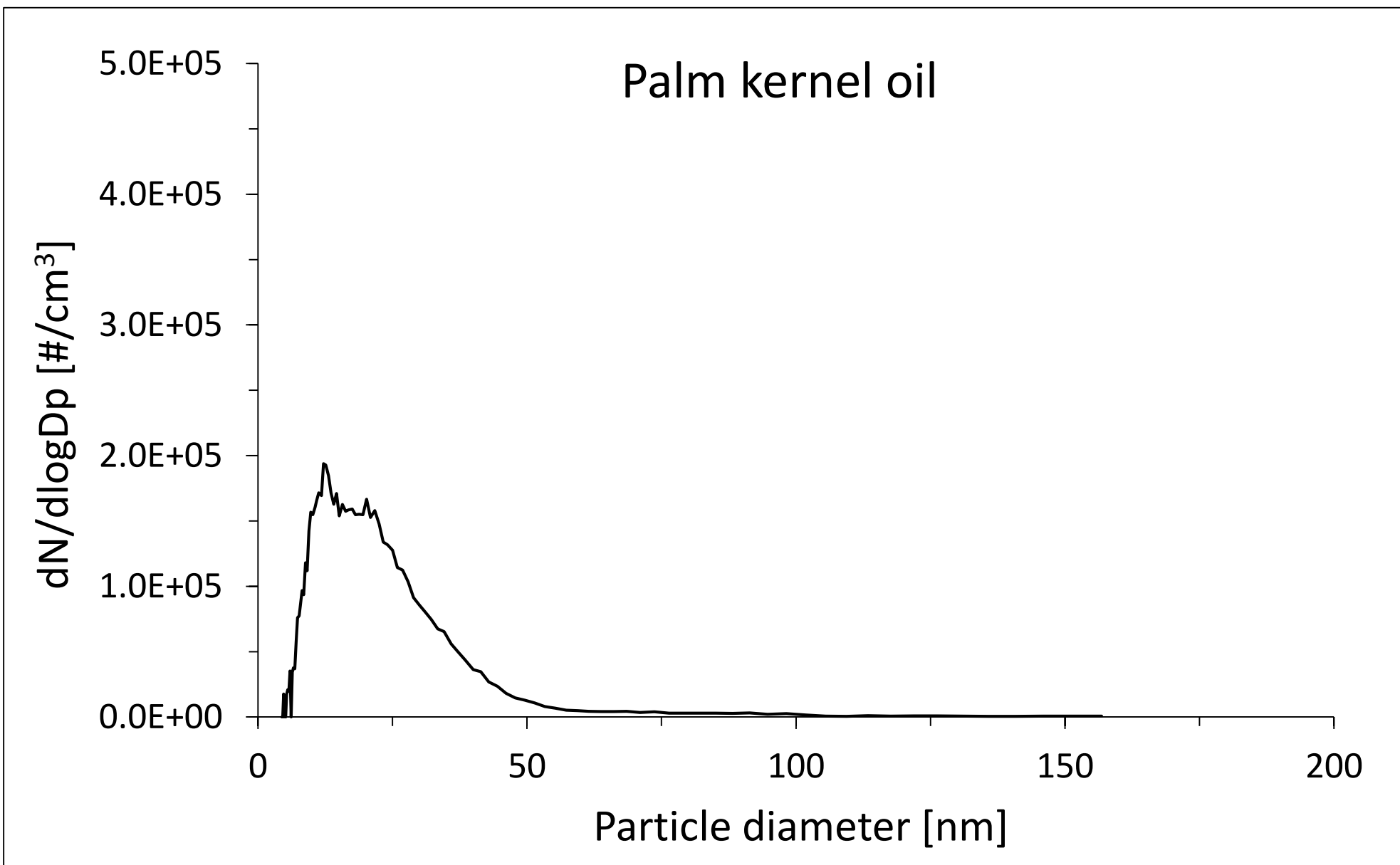
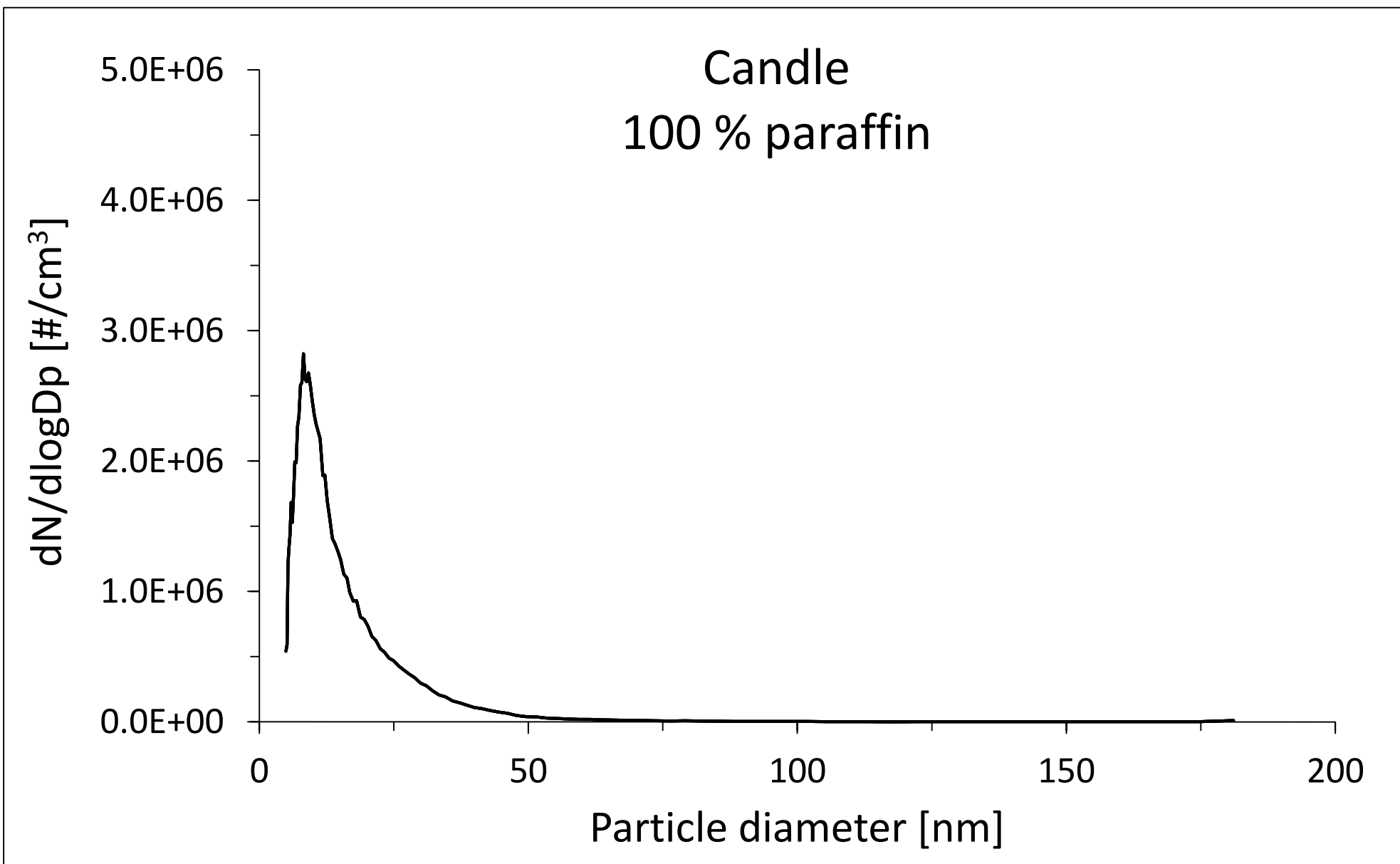
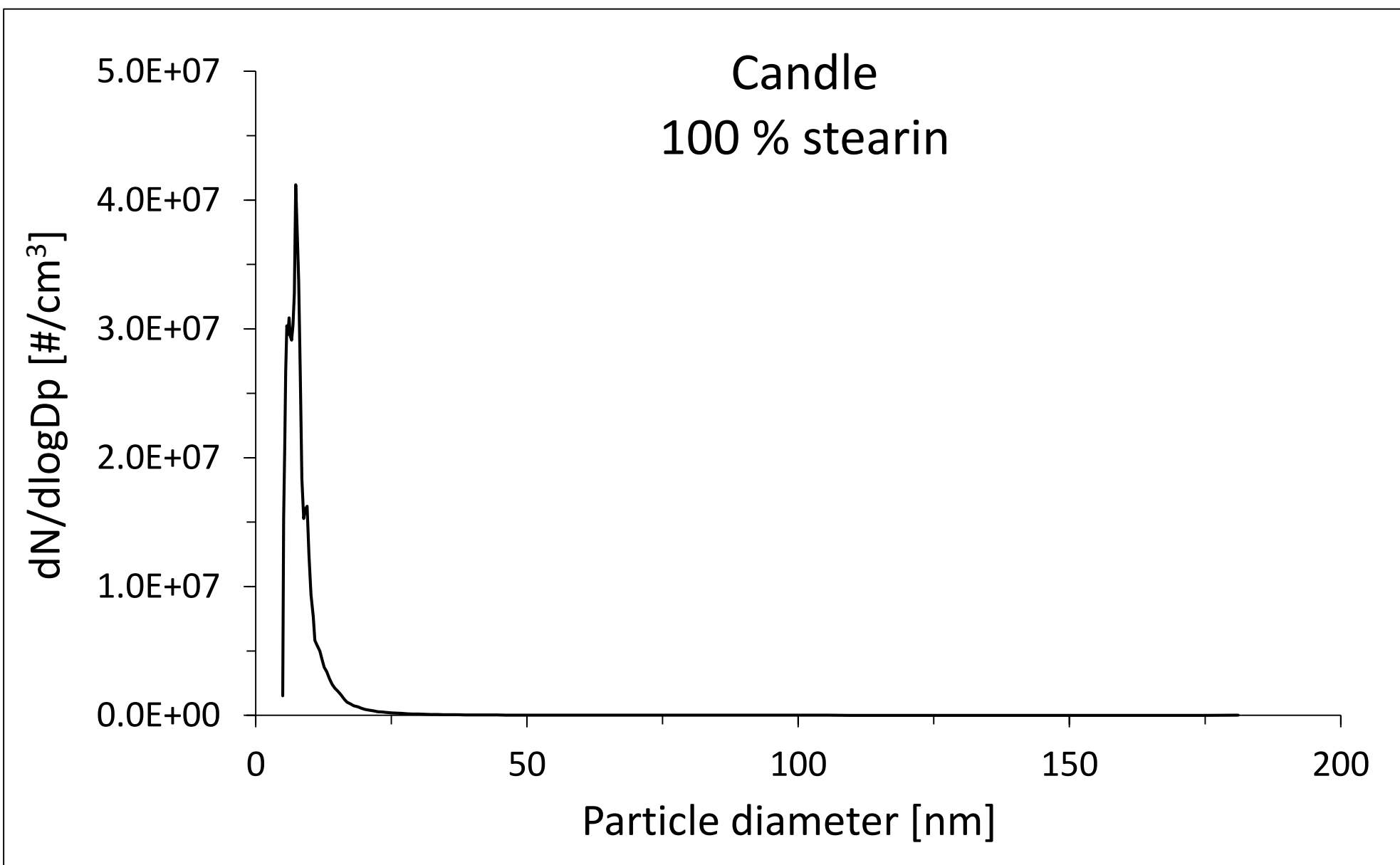


Sooting behavior has been measured on half of the samples according to the well-established standard EN15426 Candles – Specification for sooting behavior.



Measurement setup with SMPS. The set up is based on EN15426 and can be combined with measurements of sooting behavior.

## Particle size distribution



## Methods

Particle emissions have been measured using an SMPS (Scanning Mobility Particle Sizer), model 3080, nanoDMA (Differential Mobility Analyzer) model 3085, and CPC (Condensation Particle Counter), model 3776, all from TSI. The particles have been counted and size distributed in the size interval from 4.3 nm to 167 nm. All measurements have been conducted in climate room with control of temperature, relative humidity and air change.

## 16 emission tests

In the present work, particle emission from 16 different candles and oil lamps have been measured to quantify and compare the emissions from different wax types and lamp/candle types.

## Results

The measurements indicate that candles made of traditional candle wax (particularly stearin) emit a higher amount of particles than the other candles. On the other hand, it seems that the oil lamps emit by far the lowest amounts of particles together with the soya candle.

Type	Wax type	Particle concentration [#/cm <sup>3</sup> ]
Tealight	Soya	1.6(3) × 10 <sup>4</sup>
Tealight	Vegetable	3.2(2) × 10 <sup>5</sup>
Tealight	Paraffin	1.0(2) × 10 <sup>6</sup>
Tealight	Stearin	3.0(4) × 10 <sup>6</sup>
Candle	Paraffin	1.0(2) × 10 <sup>6</sup>
Candle	Stearin	8(5) × 10 <sup>6</sup>
Oil lamp	Paraffin	1.1(5) × 10 <sup>4</sup>
Oil lamp	Vegetable	6.8(4) × 10 <sup>3</sup>
Oil lamp	Palm kernel oil	8(3) × 10 <sup>4</sup>

This work was based on commercial jobs.

[1] Bekö, G., Weschler, C. J., Wierzbicka, A., Karottki, D. G., Toftum, J., Loft, S., & Clausen, G. (2013). Environ. Sci. Technol., 47, 10240-10248.