



PNC and VPR Validation
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Objective

To test the practicalities of undertaking the validation of particle number counters (PNC) and volatile particle removers (VPR), as specified in the PMP procedures, at a user's premises rather than within a specialist aerosol science laboratory.

All the necessary aerosol generation and measurement equipment was transported to a third party's premises and the validation was carried out within their facilities.

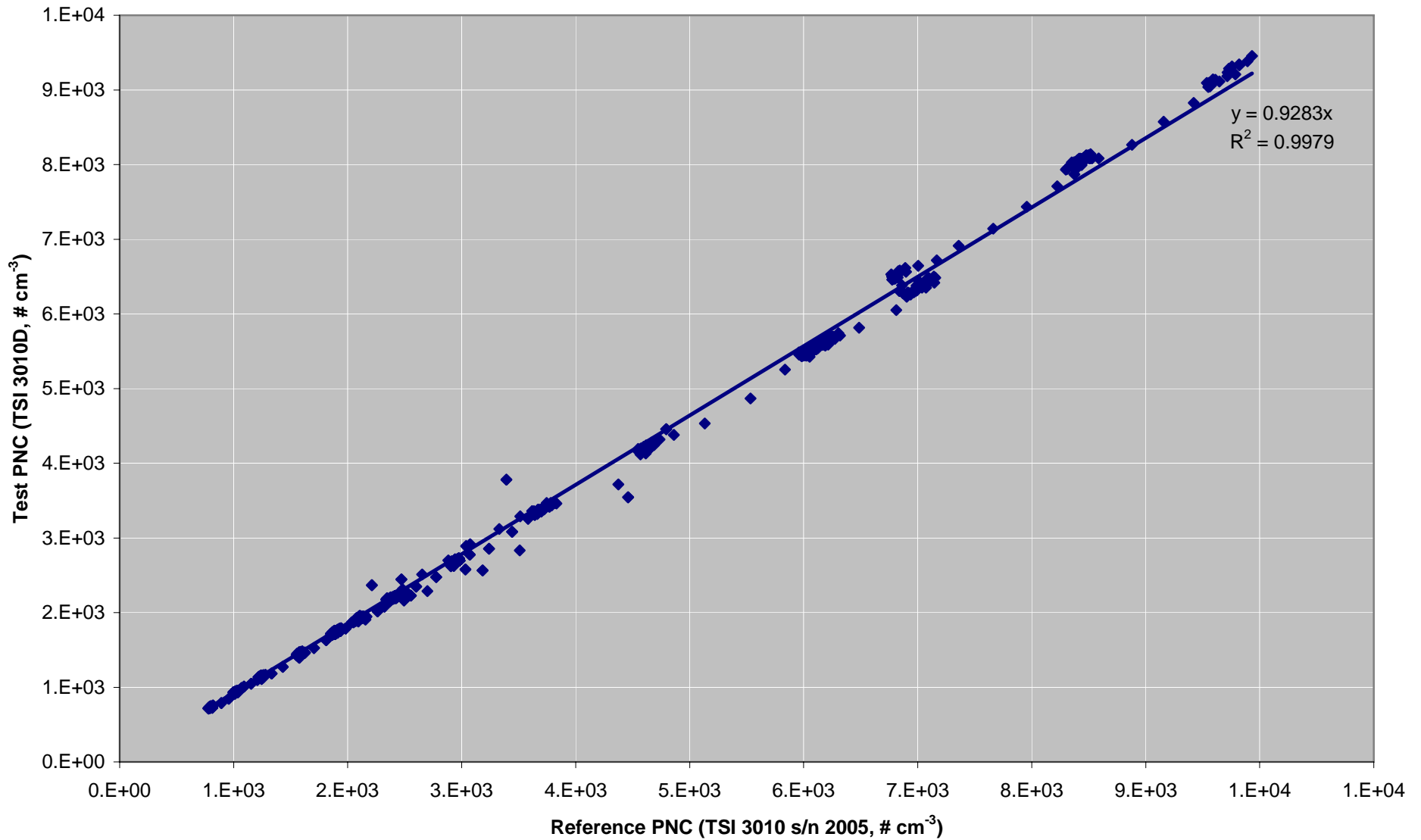
PNC Validation

A local PNC (TSI model 3010D) was compared with a reference PNC (TSI model 3010, s/n 2005) in accordance with the method described in the PMP Particle Number Counter Calibration Procedure (ED47382/PNC, Version 5, December 2007).

Sodium chloride test particles were used in the electrical mobility diameter range from 70 to 100 nm and the concentration range from ~700 to ~9,900 particles cm^{-3} .

Particle generation was by an evaporation/condensation method.

PNC Validation



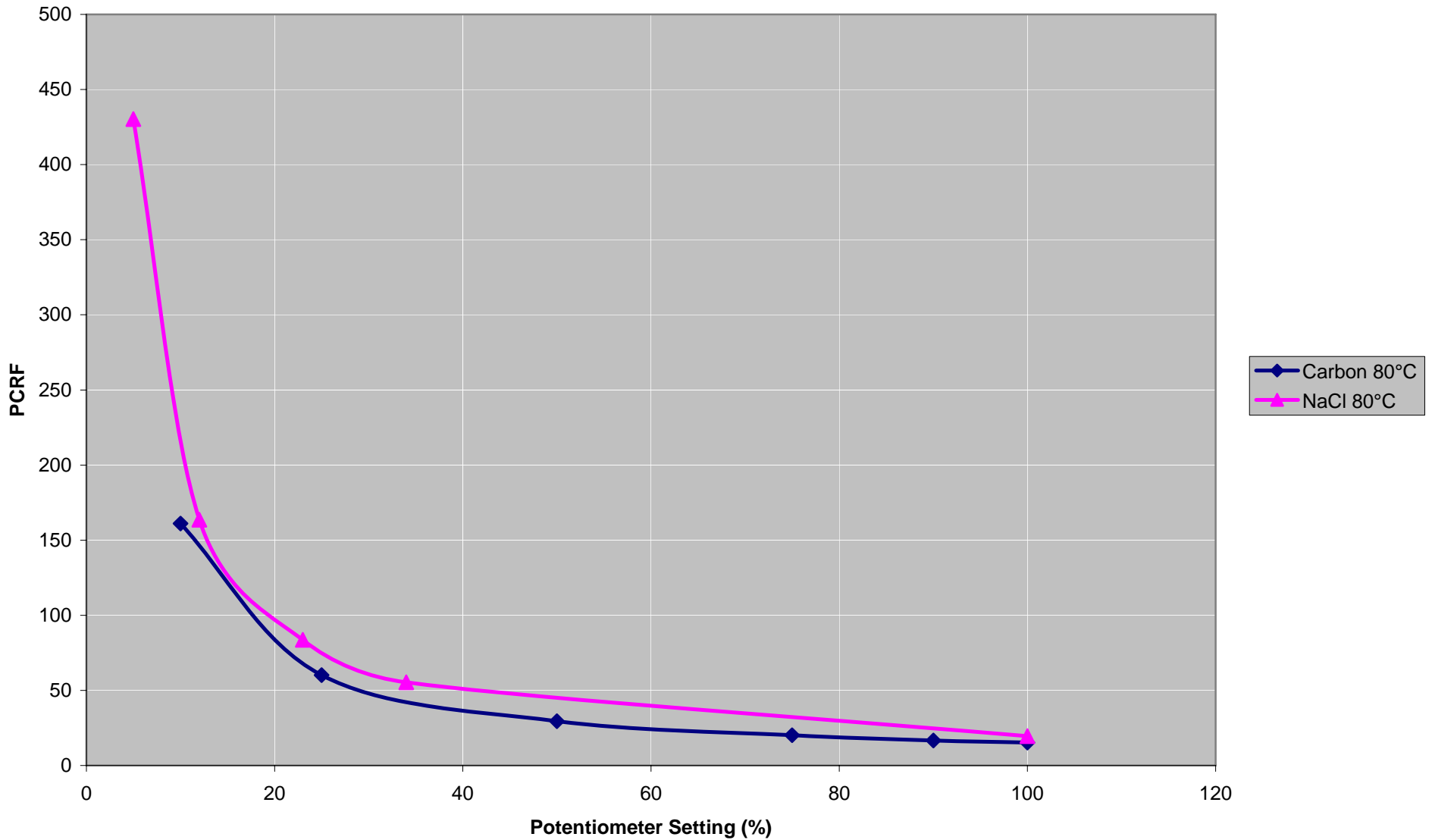
VPR Validation

A local VPR (Matter Engineering) was validated in accordance with the method described in the PMP Volatile Particle Remover Calibration Procedure (ED47382/VPR, Version 5, December 2007), using:

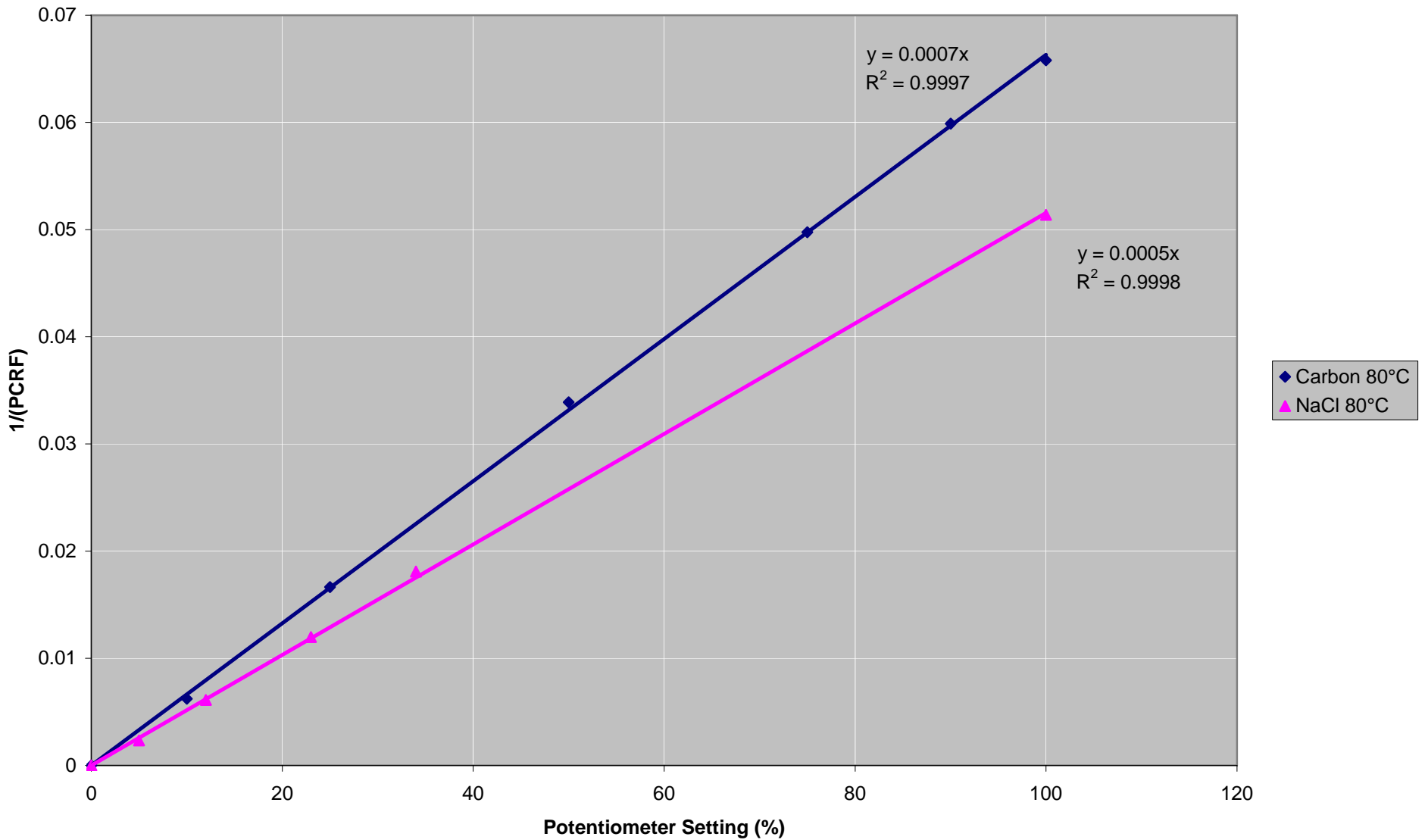
- 91 nm NaCl particles to provide a comparison with existing calibration data from CAST generated particles (PND₁ 80°C, ET 300°C, PND₂ DR 1).
- 100, 50 and 30 nm NaCl particles across a range of dilution settings (PND₁ 150°C, ET 300°C, PND₂ DR~12).
- tetracontane particles to determine the volatile particle removal efficiency (single PNC method).

Particle generation was by an evaporation/condensation method.

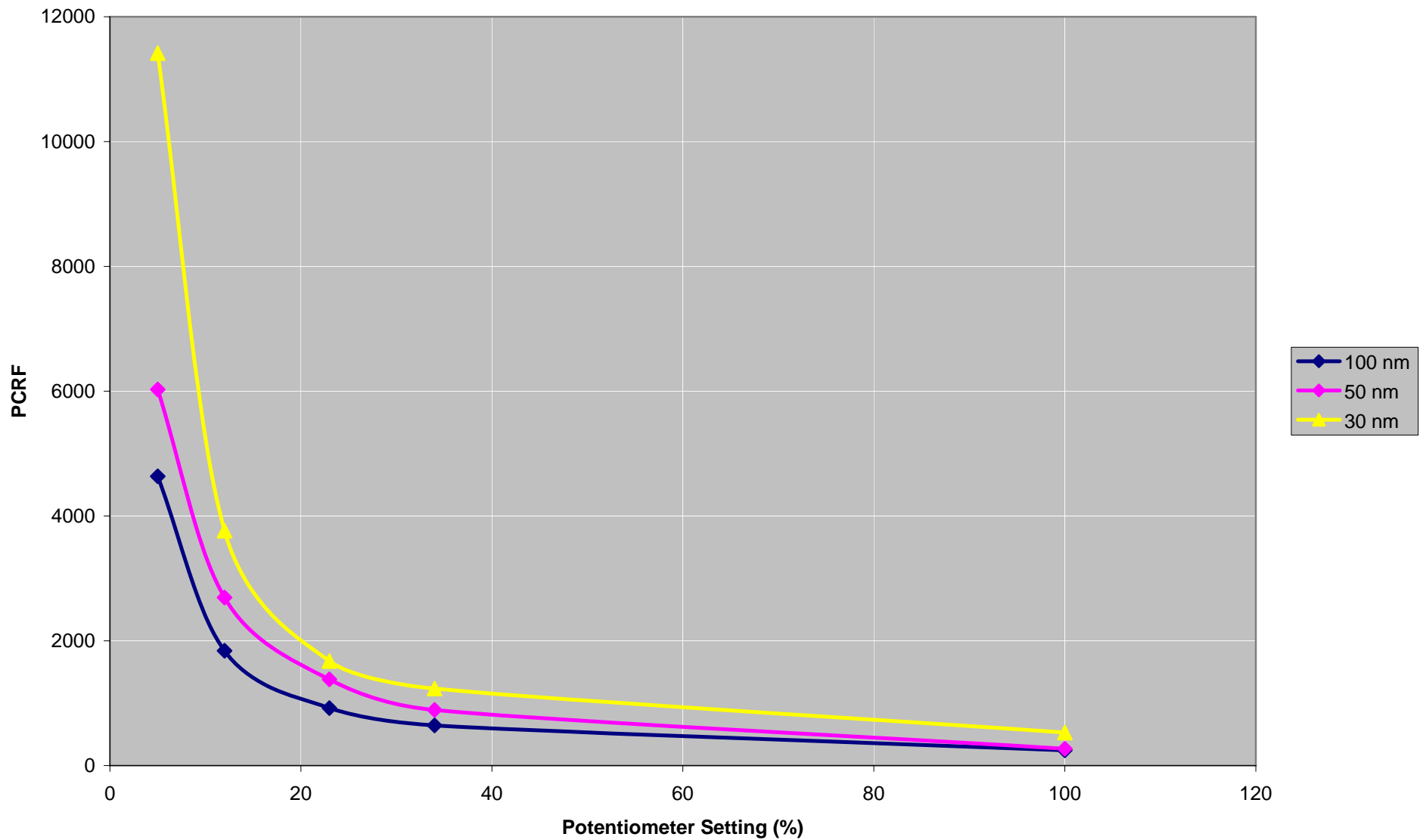
VPR Validation – NaCl/CAST @ 91 nm



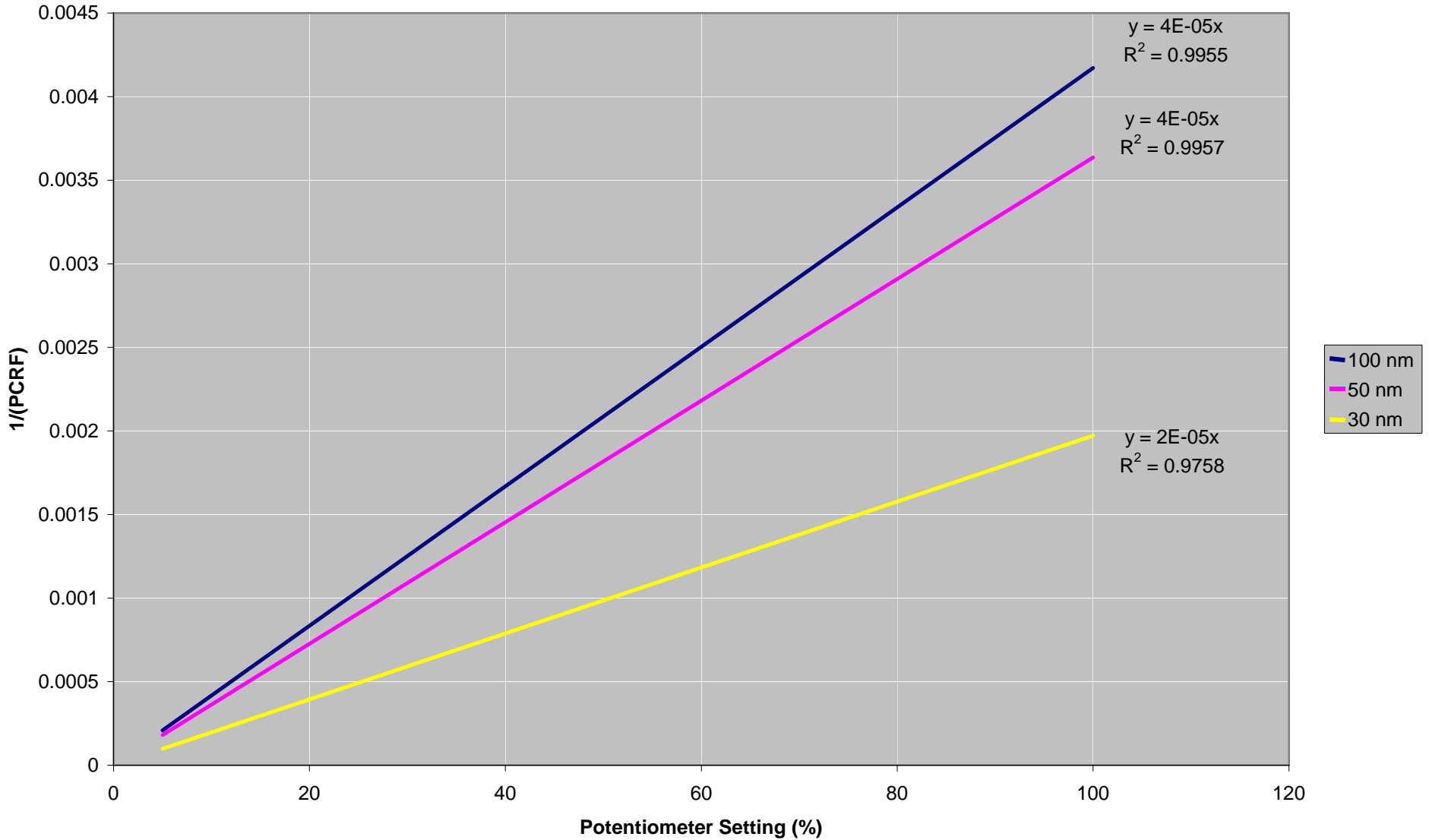
VPR Validation – NaCl/CAST @ 91 nm



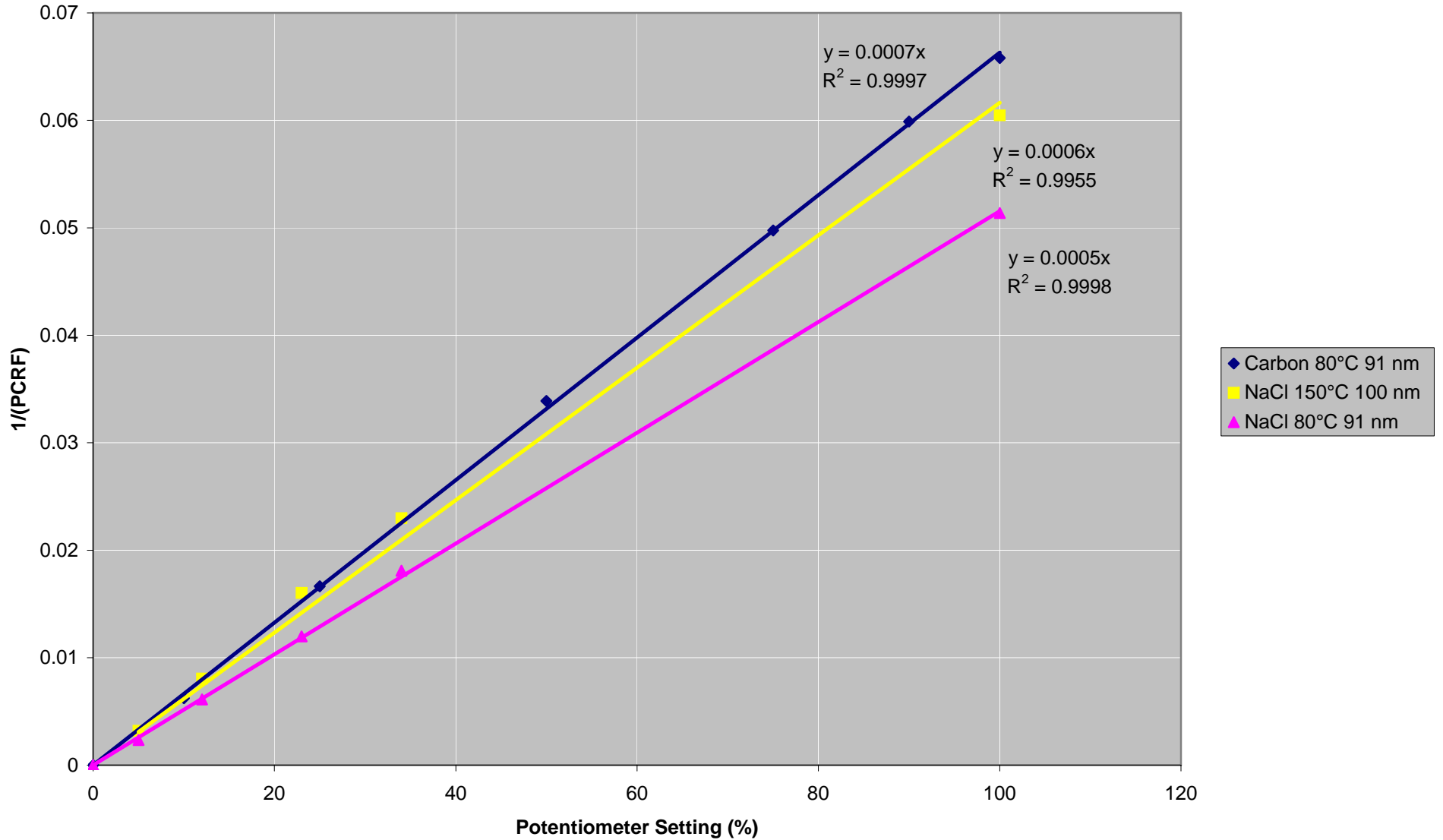
VPR Validation – NaCl @ 100, 50 & 30 nm



VPR Validation – NaCl @100, 50 & 30 nm



VPR Validation – NaCl/CAST Comparison



VPR Validation - PCRFB

Potentiometer Setting (%)	Particle Concentration Reduction Factors			$\frac{f_r(50\text{ nm})}{f_r(100\text{ nm})}$	$\frac{f_r(30\text{ nm})}{f_r(100\text{ nm})}$
	$f_r(100\text{ nm})$	$f_r(50\text{ nm})$	$f_r(30\text{ nm})$		
100	244	270	530	1.10	2.17
34	643	891	1234	1.38	1.92
23	923	1382	1676	1.50	1.82
12	1839	2692	3762	1.46	2.05
5	4634	6028	11416	1.30	2.46

VPR Validation – Volatile Removal

	Concentration (cm ⁻³)	Particles Counted
Upstream	16,256	2,709,323
Downstream Room Temperature VPR	3,220	536,733
Downstream Heated VPR	3	47,360

Conclusions

The performance of the PMP validation procedures at a user's premises is a practical proposition.

The PNC under test met the acceptance criteria when compared with a reference PNC using sodium chloride test particles.

The VPR under test met the acceptance criteria for volatile removal efficiency using tetracontane test particles.

Sodium chloride particles of 50 and 30 nm diameters did not penetrate the VPR with the expected efficiency, which resulted in particle concentration reduction factors that were significantly greater than anticipated.

Are sodium chloride particles of these diameters generated in this way stable under the temperature conditions experienced within the VPR?