WCCAP Report

CPC Workshop March 2008, Leipzig, Germany

As part of the networking activity N3, a CPC calibration workshop was conducted at the Leibniz Institute for Tropospheric Research in Leipzig, Germany in March 2008 (080302 to 080311, cf. list of participants). First, all instruments were checked for proper functioning and correct sampling flow rates. Two instruments which were broken or contaminated had to be repaired and cleaned at the institute's workshop. All together 27 CPCs from 20 institutions in 14 European countries were checked and calibrated, partly twice. Therefore a multiple counter calibration setup was used (cf. Hermann et al., 2007). The particle number concentration measured by each CPC was compared to the reading of an aerosol electrometer, which can be considered as an absolute standard in this context. For each CPC at least two calibration curves with sodium chloride were conducted. Raw data were corrected for electrometer offset, coincidence in the CPC optics, and diffusional losses in the sampling lines.

The resulting final two counting efficiency curves for each CPC were averaged and a fitting function was applied to the data. These counting efficiency curves are shown for each individual CPC on the following pages. For the fitting function the following equations were used to derive the counting efficiency „eta" as function of the particle diameter „dp":

for the CPC models 3025	$eta = a - b / (\exp(c * \log(d_p)) - d)$
for all other CPC models, called „3010"	$eta = a - b / (1.0 + \exp((d_p - c) / d))$

The obtained fitting functions will be used as an important input parameter for SMPS/DMPS data inversion algorithms (cf. SMPS/DMPS workshop report).

References

Hermann, M., Wehner, B., Bischof, O., Han, H.-S., Krinke, T., Liu, W., Zerrath, A., and Wiedensohler, A., Particle counting efficiency of new TSI condensation particle counters, submitted to J. Aerosol Sci., 2007.

List of participants of the EUSAAR CPC workshop in March 2008

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Harald Flentje	DWD station	Hohenpeißenberg	Germany

Table of CPCs for workshop in March 2008

Figure	Location	Type	Spectrometer relevant?
Fig. 1	Athens	TSI 3776	yes
Fig. 2	Kjeller	TSI 3010	yes
Fig. 3	Clermont	TSI 3010	yes
Fig. 4	Helsinki	TSI 3772	yes
Fig. 5	Leipzig	TSI 3010	no
Fig. 6	Leipzig	TSI 3025	yes
Fig. 7	Leipzig	TSI 3010	yes
Fig. 8	Ispra	TSI 3010	yes
Fig. 9	Bologna	TSI 3010	yes
Fig. 10	Veszprem	TSI 3010	yes
Fig. 11	Villigen	TSI 3022	yes
Fig. 12	Birmingham	TSI 3775	yes
Fig. 13	Oberried	TSI 3772	yes
Fig. 14	Oberried	TSI 3782	no
Fig. 15	Hohenpeißenberg	TSI 3772	yes
Fig. 16	Hohenpeißenberg	TSI 3010	no
Fig. 17	Garmisch	TSI 3772	yes
Fig. 18	Garmisch	TSI 3785	no
Fig. 19	Garmisch	TSI 3772	no
Fig. 20	Heraklion	TSI 3772	yes
Fig. 21	Prag	TSI 3775	yes
Fig. 22	Sofia	TSI 3772	yes
Fig. 23	Veszprem	TSI 3010	no
Fig. 24	Bologna	TSI 3010	no
Fig. 25	Lund	TSI 3760	yes
Fig. 26	Lund	TSI 3025	yes
Fig. 27	Vilnius	DK 1	yes

Counting efficiency curves for the CPCs calibrated during the EUSAAR workshop in March 2008

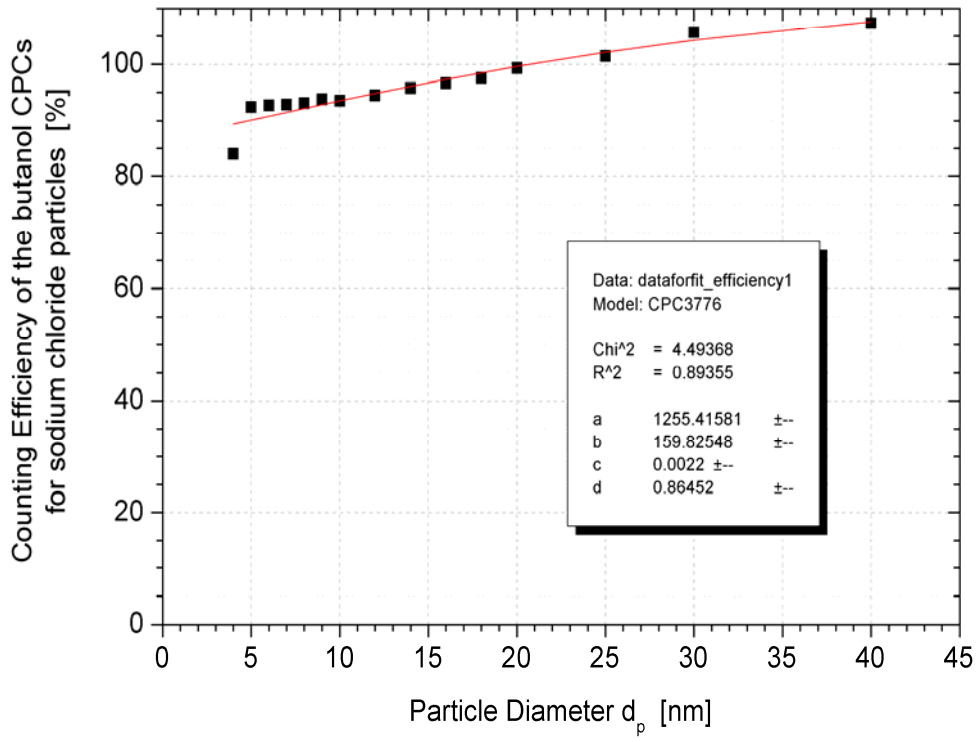

Fig. 1

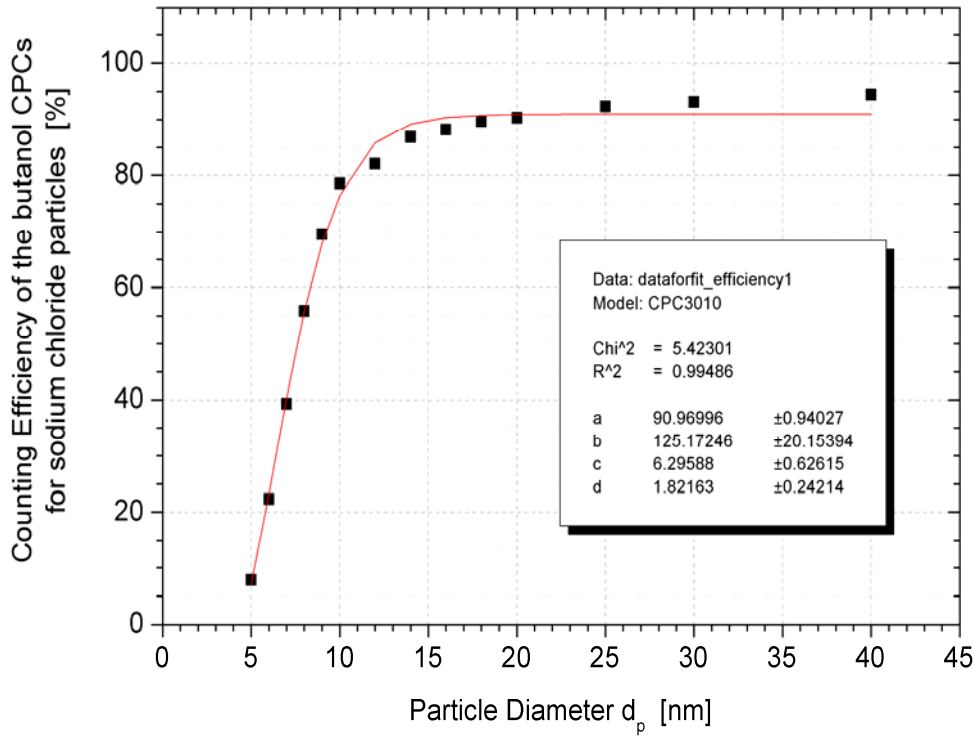

Fig. 2

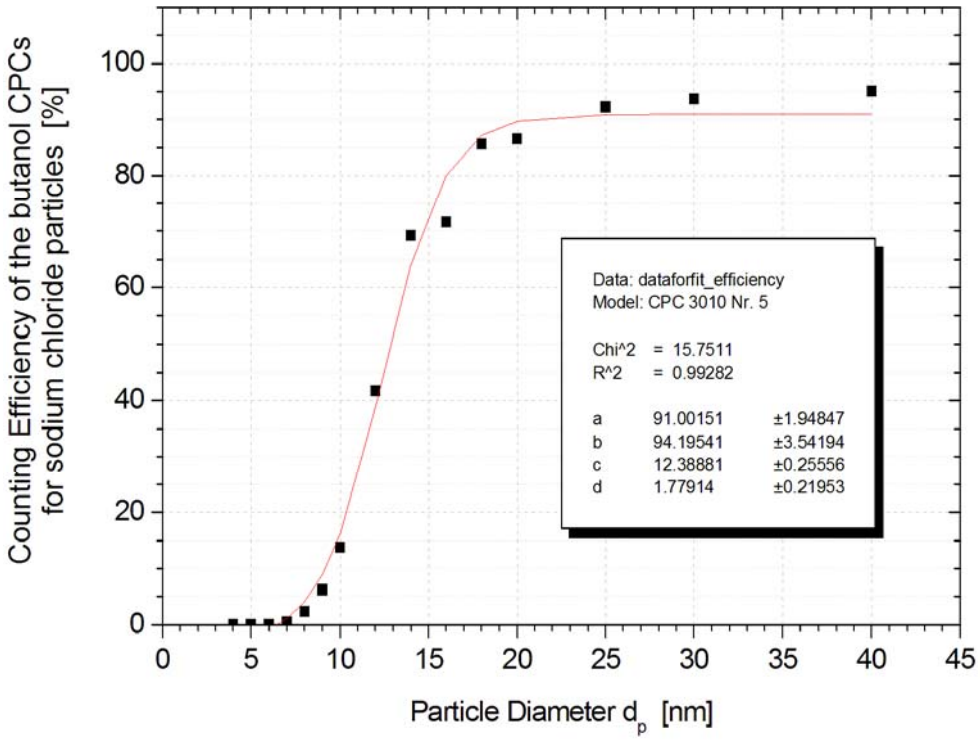
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency
Model: CPC 3010 Nr. 5
Chi^2 = 15.7511
R^2 = 0.99282
a 91.00151 ±1.94847
b 94.19541 ±3.54194
c 12.38881 ±0.25556
d 1.77914 ±0.21953

Fig. 3

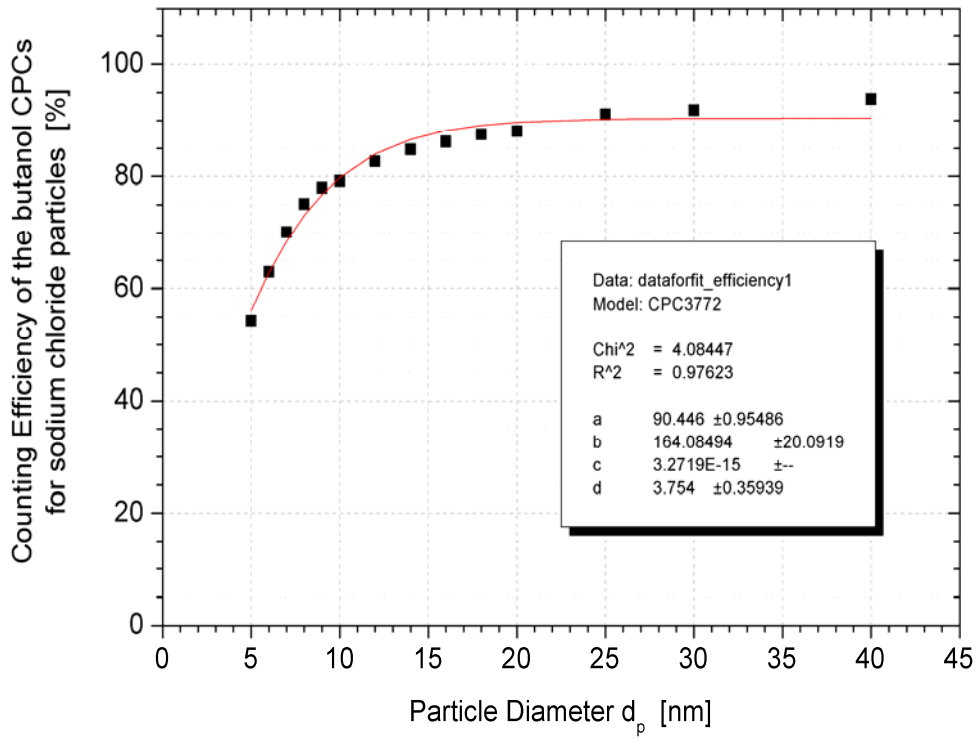
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3772
Chi^2 = 4.08447
R^2 = 0.97623
a 90.446 ±0.95486
b 164.08494 ±20.0919
c 3.2719E-15 ±--
d 3.754 ±0.35939

Fig. 4

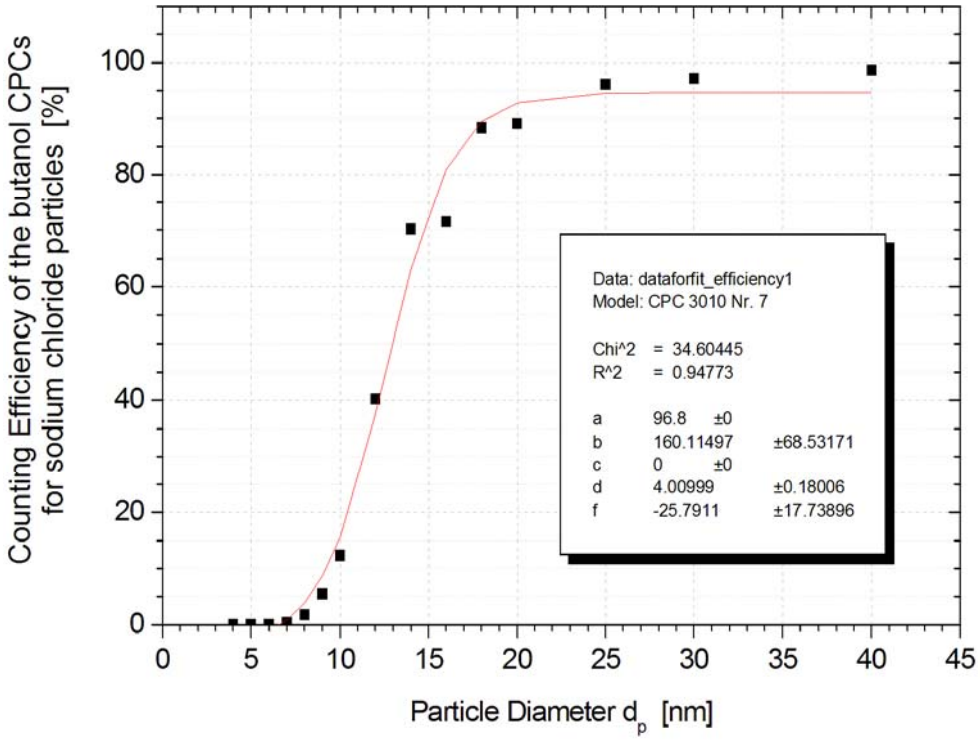
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC 3010 Nr. 7
Chi^2 = 34.60445
R^2 = 0.94773
a 96.8 ±0
b 160.11497 ±68.53171
c 0 ±0
d 4.00999 ±0.18006
f -25.7911 ±17.73896

Fig. 5

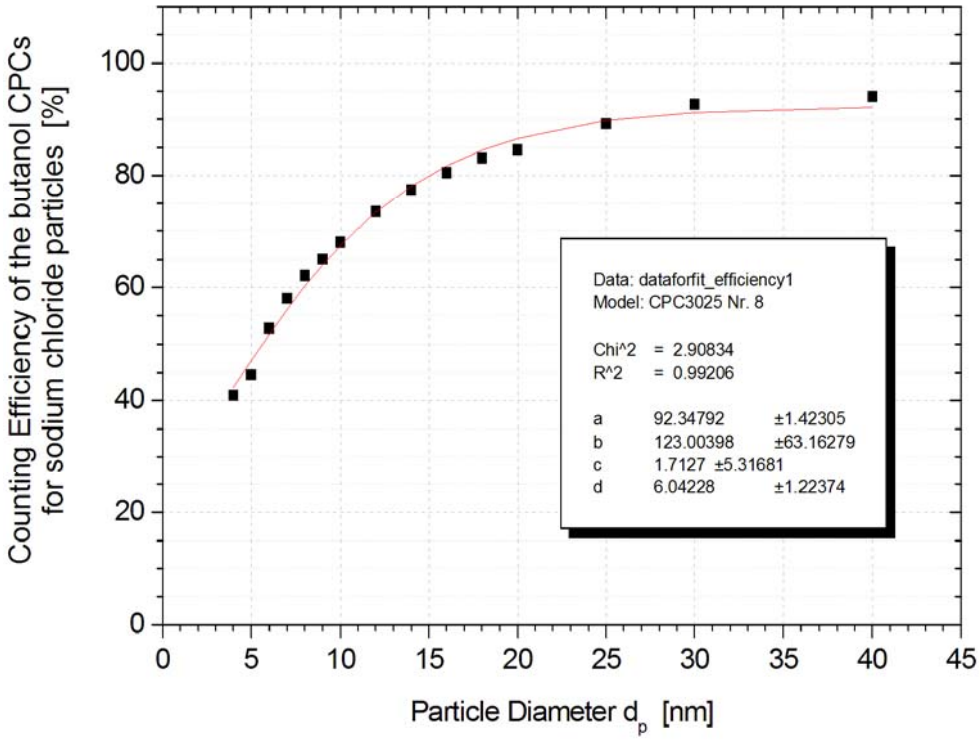
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3025 Nr. 8
Chi^2 = 2.90834
R^2 = 0.99206
a 92.34792 ±1.42305
b 123.00398 ±63.16279
c 1.7127 ±5.31681
d 6.04228 ±1.22374

Fig. 6

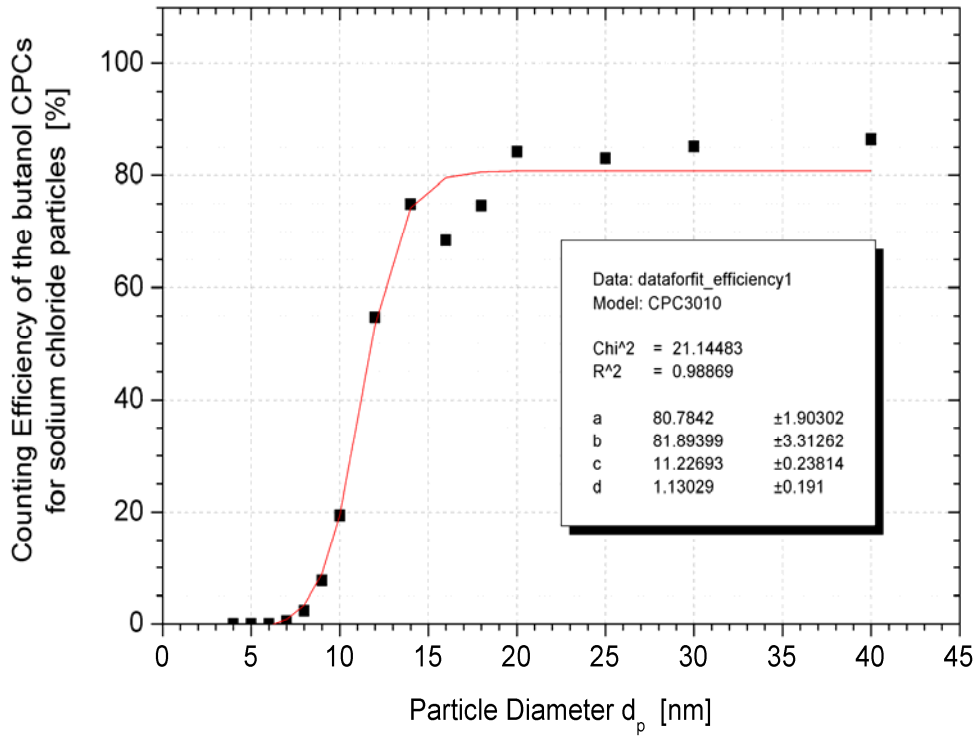
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3010
Chi^2 = 21.14483
R^2 = 0.98869
a 80.7842 ±1.90302
b 81.89399 ±3.31262
c 11.22693 ±0.23814
d 1.13029 ±0.191

Fig. 7

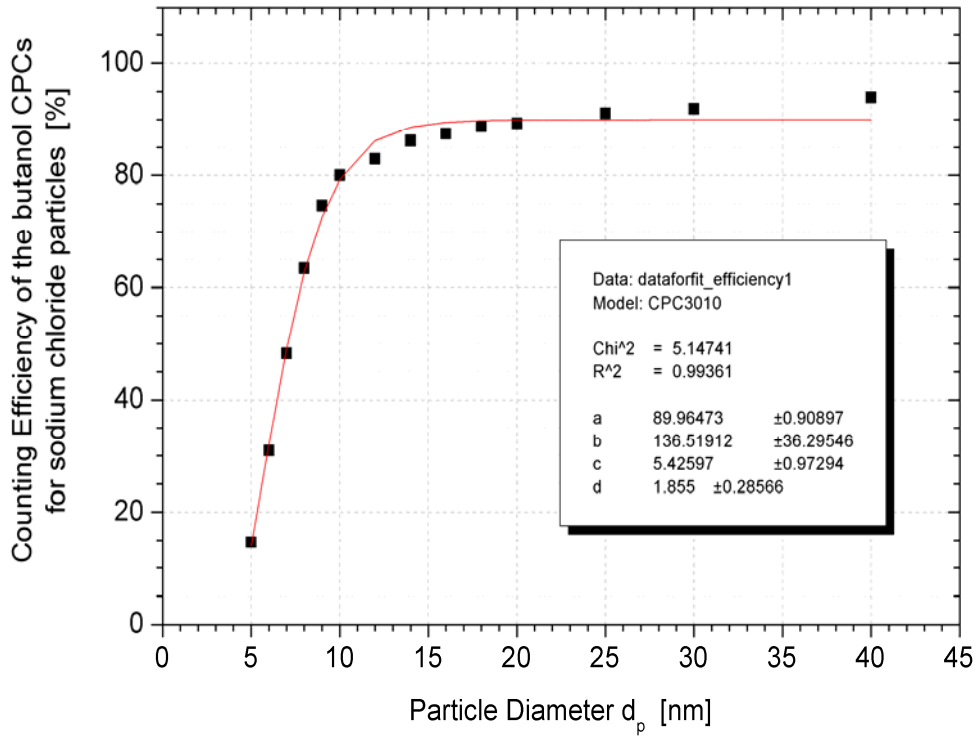
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3010
Chi^2 = 5.14741
R^2 = 0.99361
a 89.96473 ±0.90897
b 136.51912 ±36.29546
c 5.42597 ±0.97294
d 1.855 ±0.28566

Fig. 8

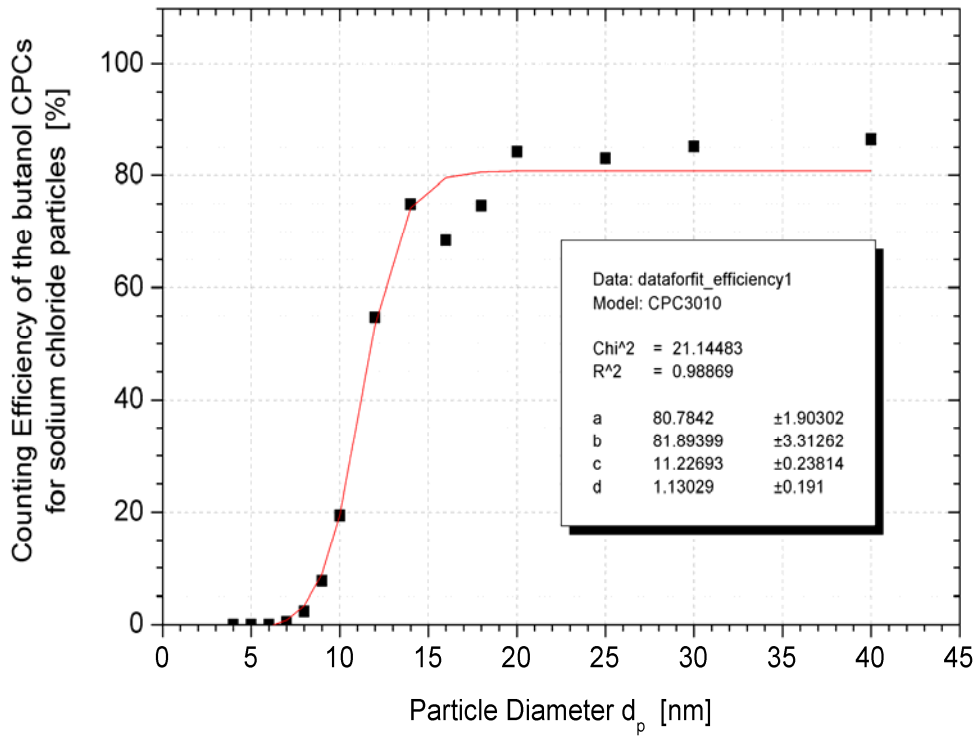
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3010
Chi^2 = 21.14483
R^2 = 0.98869
a 80.7842 ±1.90302
b 81.89399 ±3.31262
c 11.22693 ±0.23814
d 1.13029 ±0.191

Fig. 9

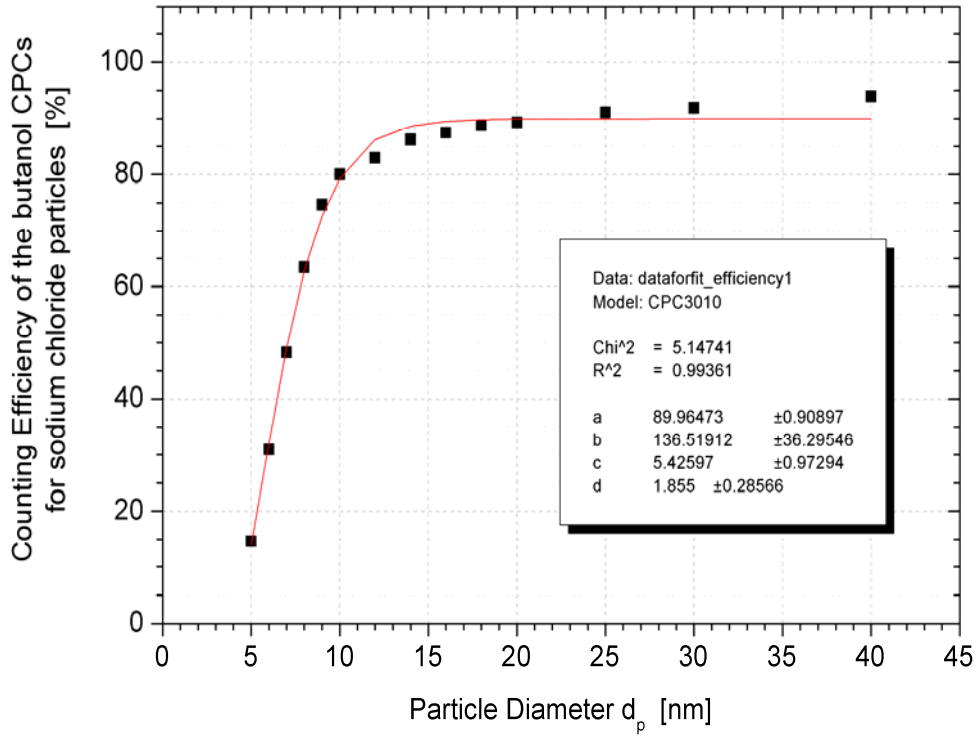
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3010
Chi^2 = 5.14741
R^2 = 0.99361
a 89.96473 ±0.90897
b 136.51912 ±36.29546
c 5.42597 ±0.97294
d 1.855 ±0.28566

Fig. 10

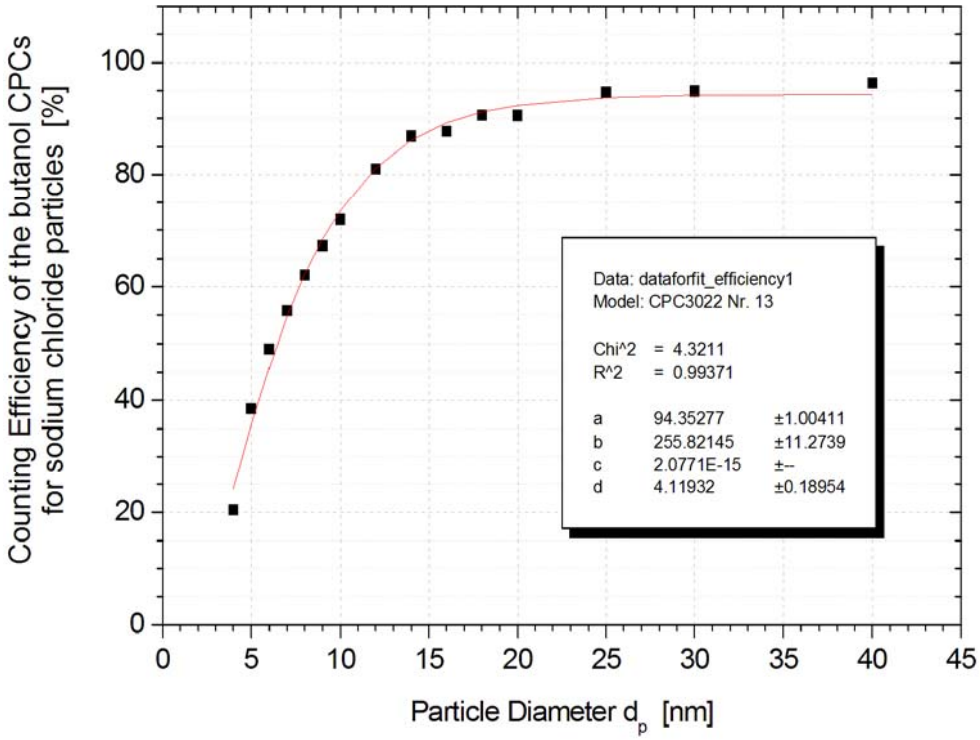
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3022 Nr. 13
Chi^2 = 4.3211
R^2 = 0.99371
a 94.35277 ±1.00411
b 255.82145 ±11.2739
c 2.0771E-15 ±--
d 4.11932 ±0.18954

Fig. 11

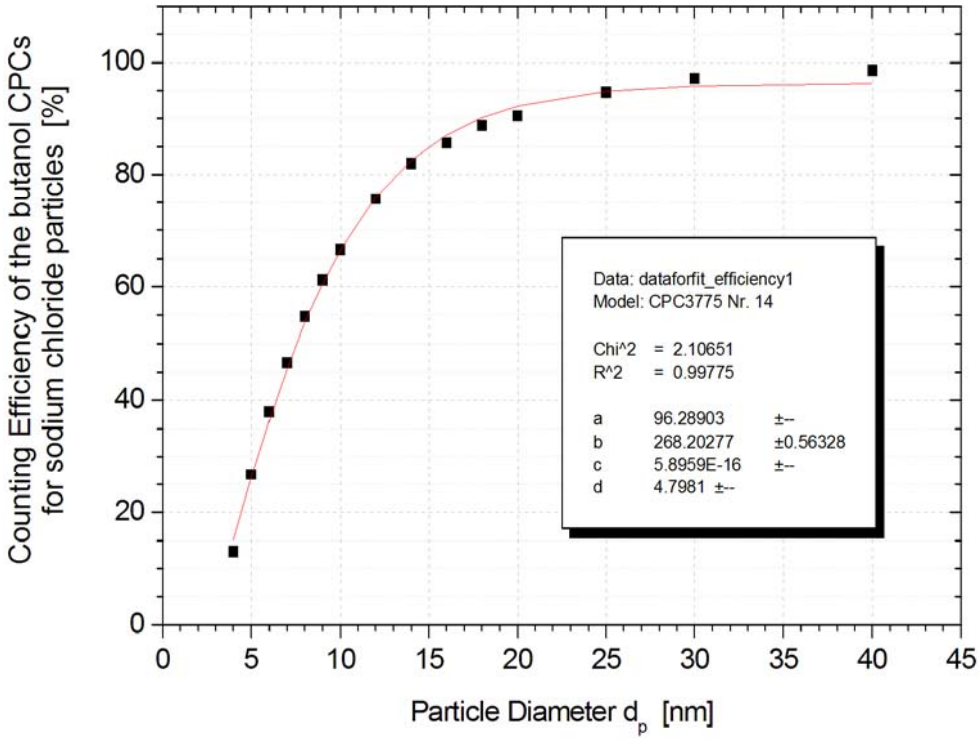
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3775 Nr. 14
Chi^2 = 2.10651
R^2 = 0.99775
a 96.28903 ±--
b 268.20277 ±0.56328
c 5.8959E-16 ±--
d 4.7981 ±--

Fig. 12

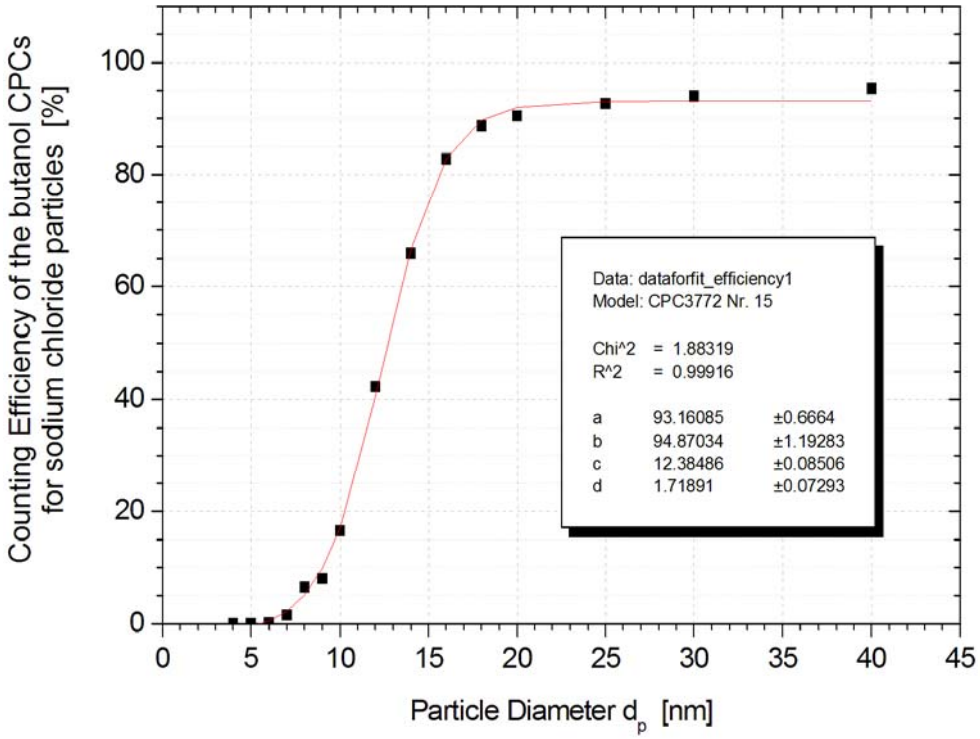
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3772 Nr. 15
Chi^2 = 1.88319
R^2 = 0.99916
a 93.16085 ±0.6664
b 94.87034 ±1.19283
c 12.38486 ±0.08506
d 1.71891 ±0.07293

Fig. 13

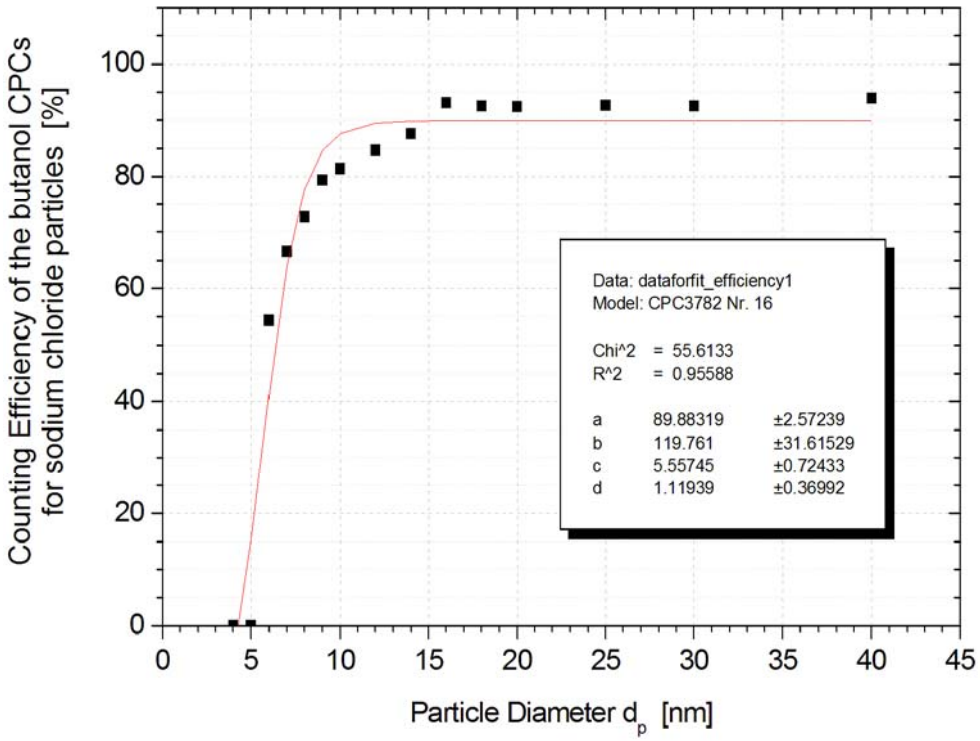
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3782 Nr. 16
Chi^2 = 55.6133
R^2 = 0.95588
a 89.88319 ±2.57239
b 119.761 ±31.61529
c 5.55745 ±0.72433
d 1.11939 ±0.36992

Fig. 14

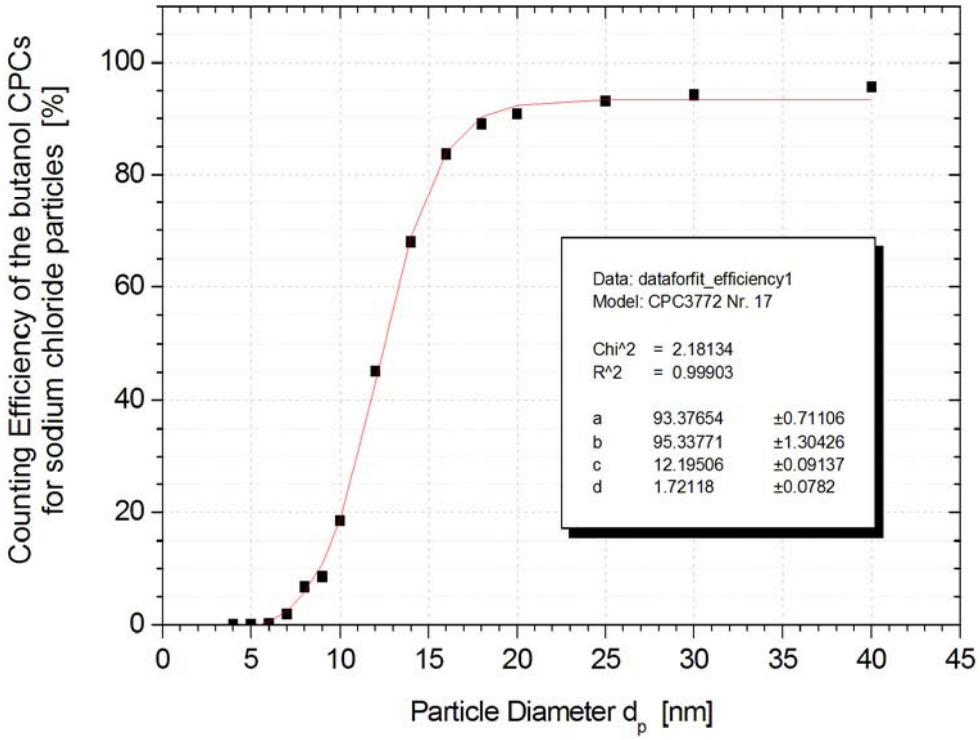
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3772 Nr. 17
Chi^2 = 2.18134
R^2 = 0.99903
a 93.37654 ±0.71106
b 95.33771 ±1.30426
c 12.19506 ±0.09137
d 1.72118 ±0.0782

Fig. 15

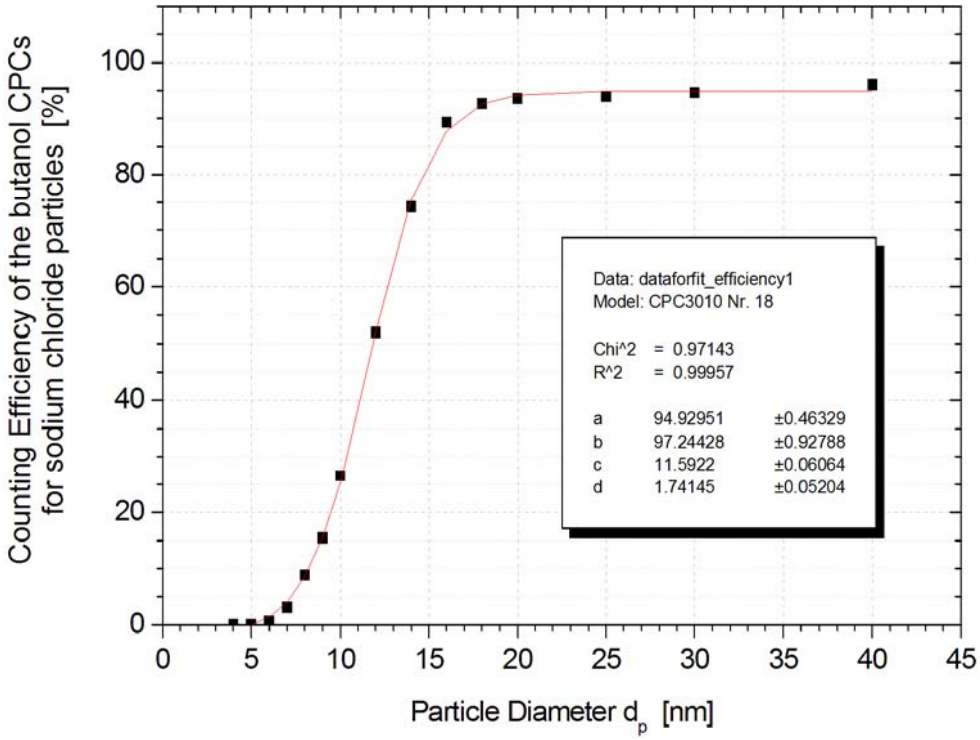
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3010 Nr. 18
Chi^2 = 0.97143
R^2 = 0.99957
a 94.92951 ±0.46329
b 97.24428 ±0.92788
c 11.5922 ±0.06064
d 1.74145 ±0.05204

Fig. 16

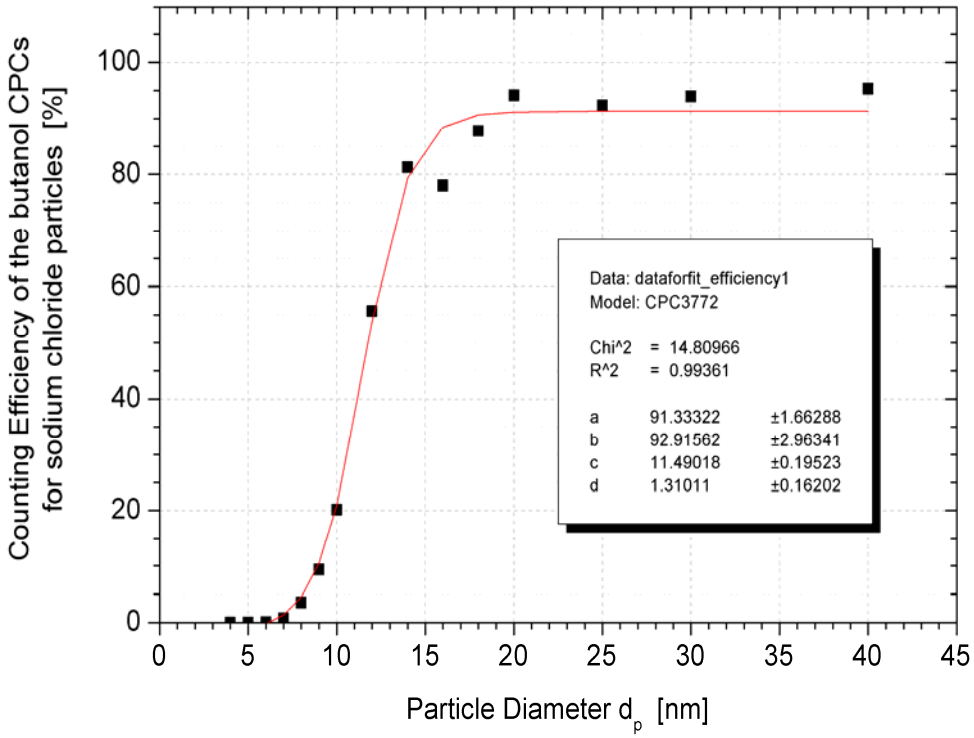
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3772
Chi^2 = 14.80966
R^2 = 0.99361
a 91.33322 ±1.66288
b 92.91562 ±2.96341
c 11.49018 ±0.19523
d 1.31011 ±0.16202

Fig. 17

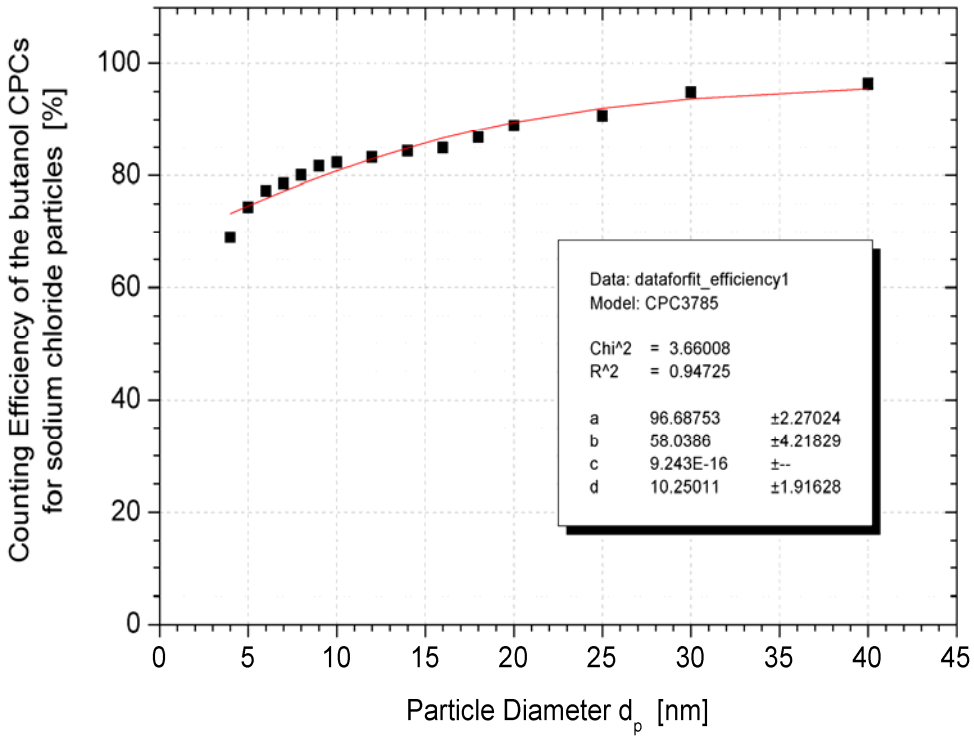
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3785
Chi^2 = 3.66008
R^2 = 0.94725
a 96.68753 ±2.27024
b 58.0386 ±4.21829
c 9.243E-16 ±--
d 10.25011 ±1.91628

Fig. 18

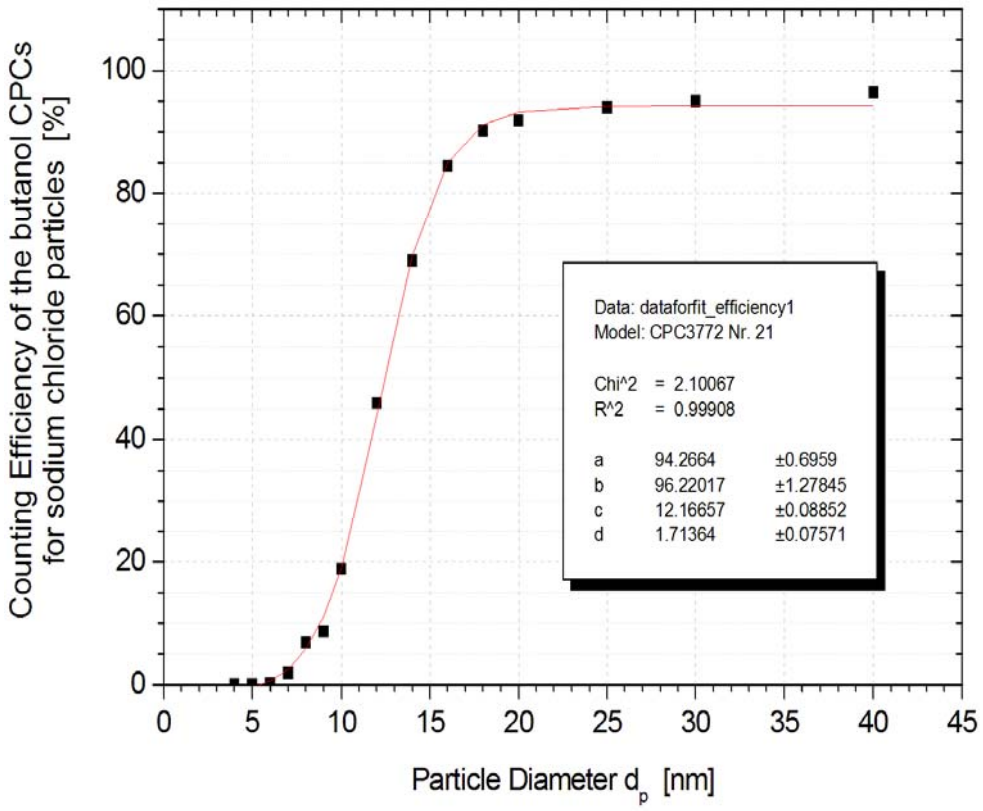
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3772 Nr. 21
Chi^2 = 2.10067
R^2 = 0.99908
a 94.2664 ±0.6959
b 96.22017 ±1.27845
c 12.16657 ±0.08852
d 1.71364 ±0.07571

Fig. 19

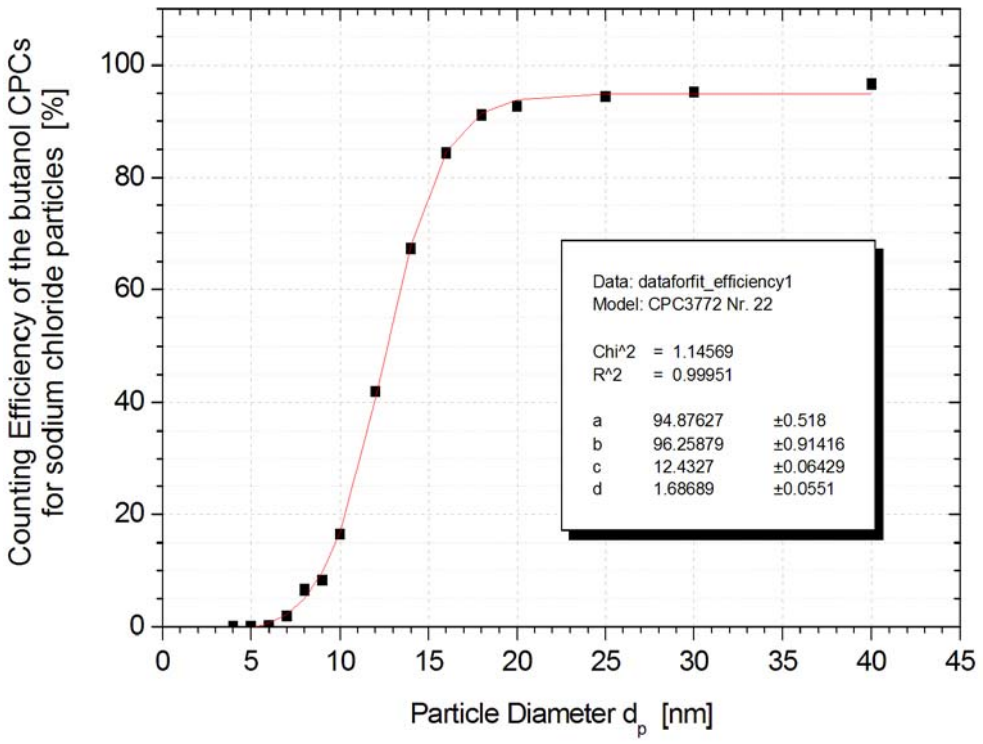
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3772 Nr. 22
Chi^2 = 1.14569
R^2 = 0.99951
a 94.87627 ±0.518
b 96.25879 ±0.91416
c 12.4327 ±0.06429
d 1.68689 ±0.0551

Fig. 20

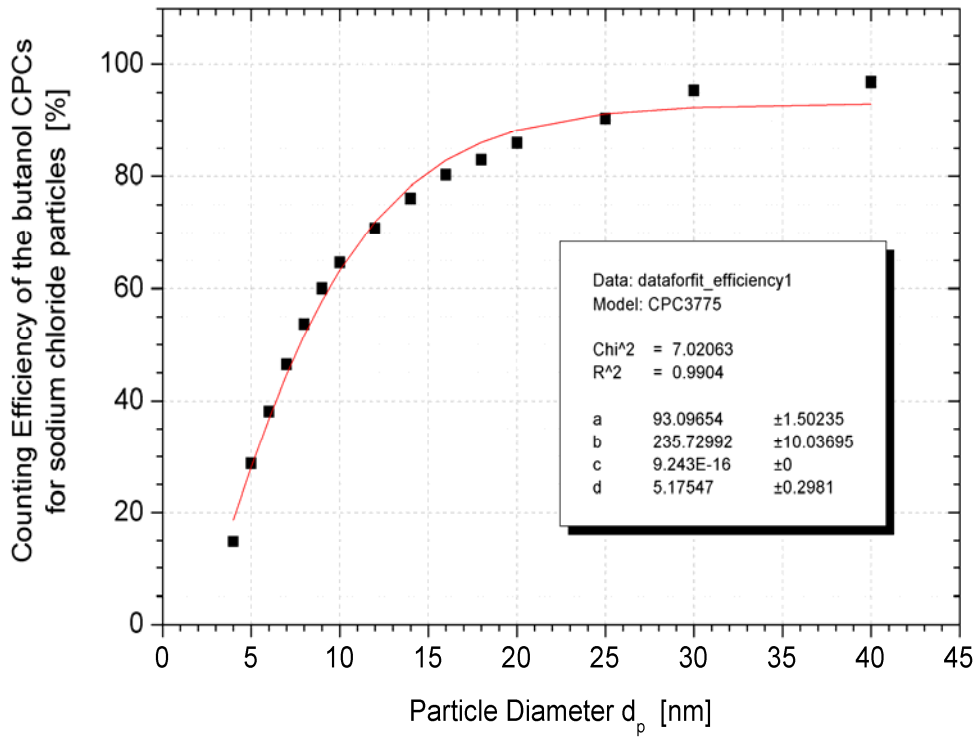
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3775
Chi^2 = 7.02063
R^2 = 0.9904
a 93.09654 ±1.50235
b 235.72992 ±10.03695
c 9.243E-16 ±0
d 5.17547 ±0.2981

Fig. 21

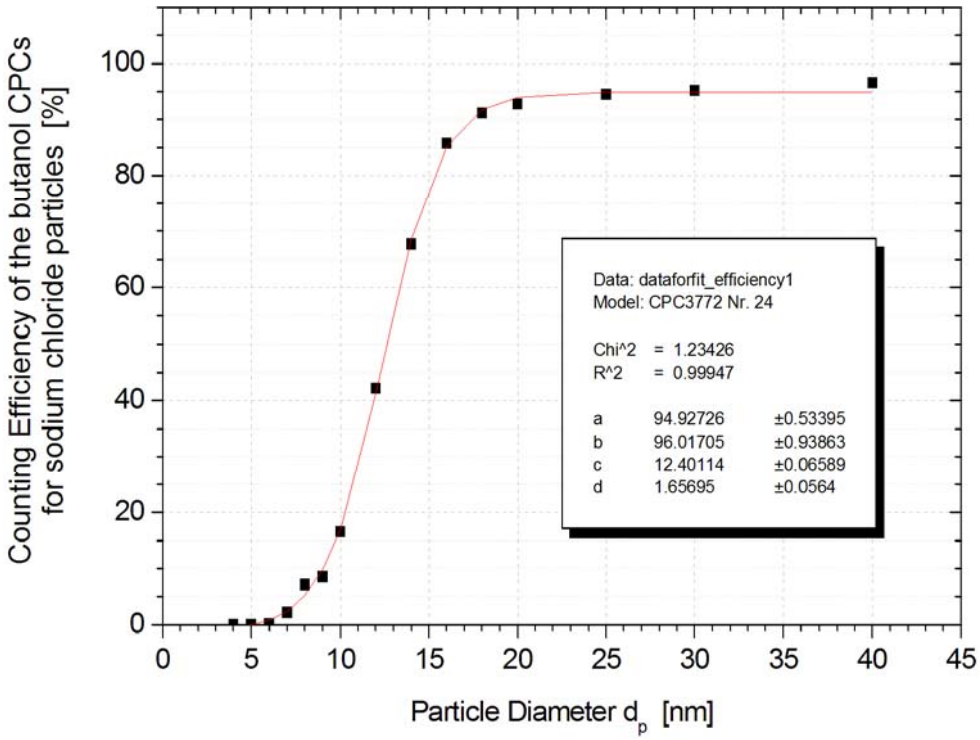
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3772 Nr. 24
Chi^2 = 1.23426
R^2 = 0.99947
a 94.92726 ±0.53395
b 96.01705 ±0.93863
c 12.40114 ±0.06589
d 1.65695 ±0.0564

Fig. 22

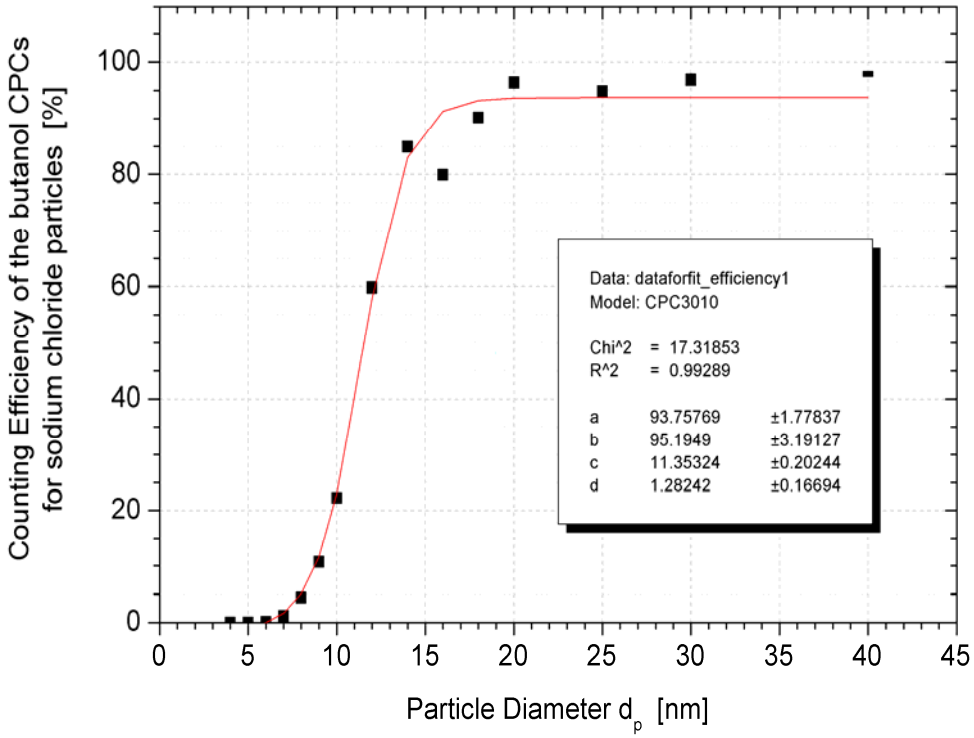
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3010
Chi^2 = 17.31853
R^2 = 0.99289
a 93.75769 ±1.77837
b 95.1949 ±3.19127
c 11.35324 ±0.20244
d 1.28242 ±0.16694

Fig. 23

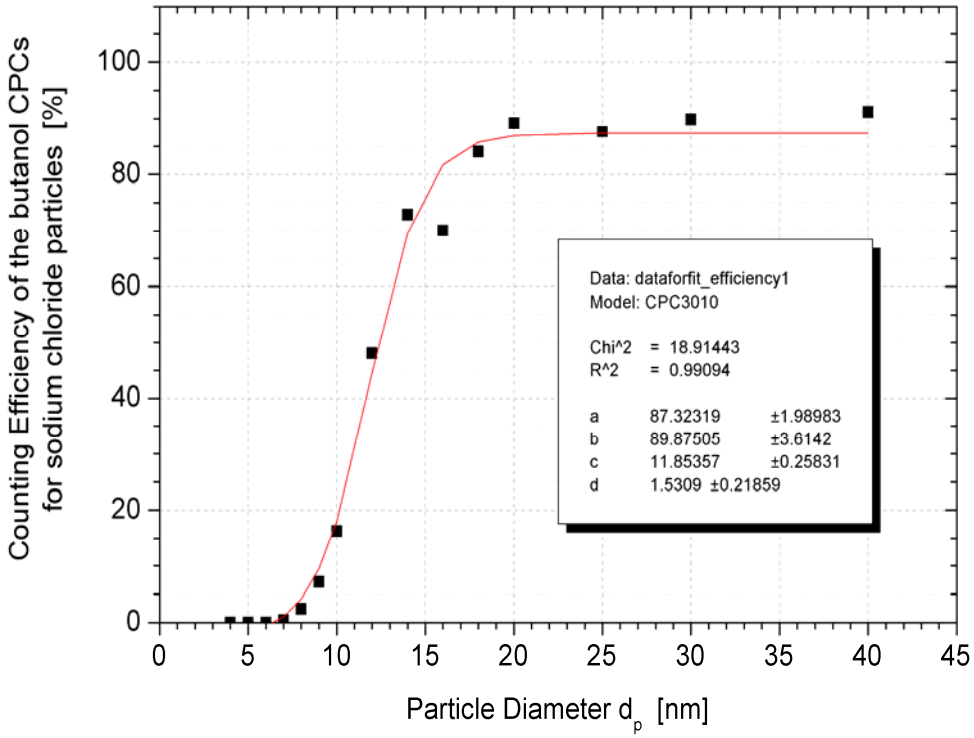
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3010
Chi^2 = 18.91443
R^2 = 0.99094
a 87.32319 ±1.98983
b 89.87505 ±3.6142
c 11.85357 ±0.25831
d 1.5309 ±0.21859

Fig. 24

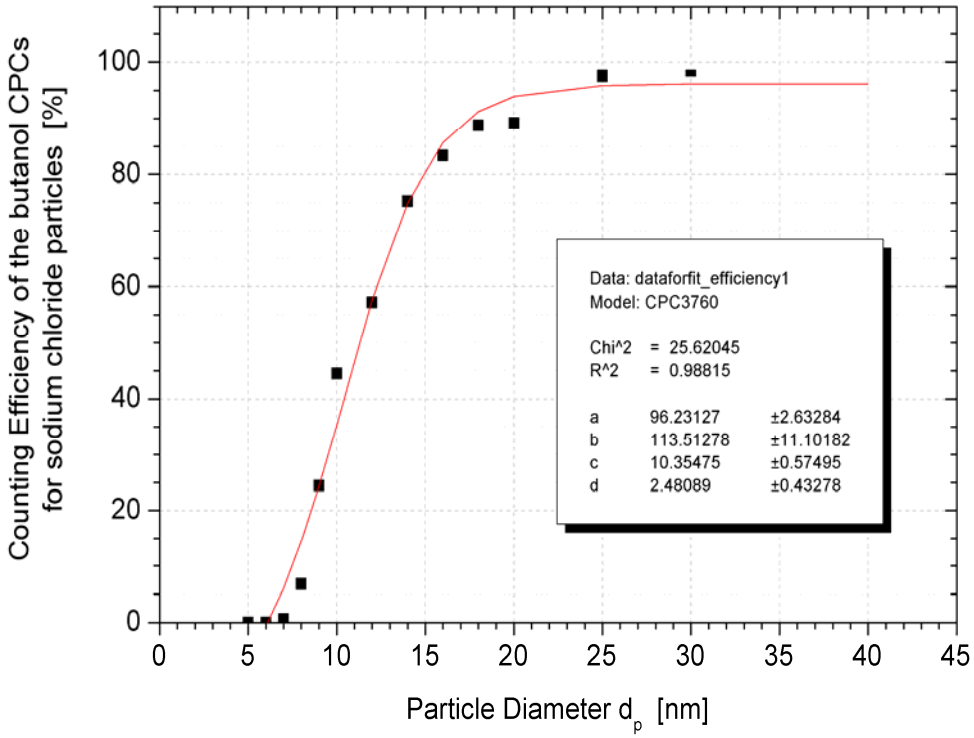
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3760
Chi^2 = 25.62045
R^2 = 0.98815
a 96.23127 ±2.63284
b 113.51278 ±11.10182
c 10.35475 ±0.57495
d 2.48089 ±0.43278

Fig. 25

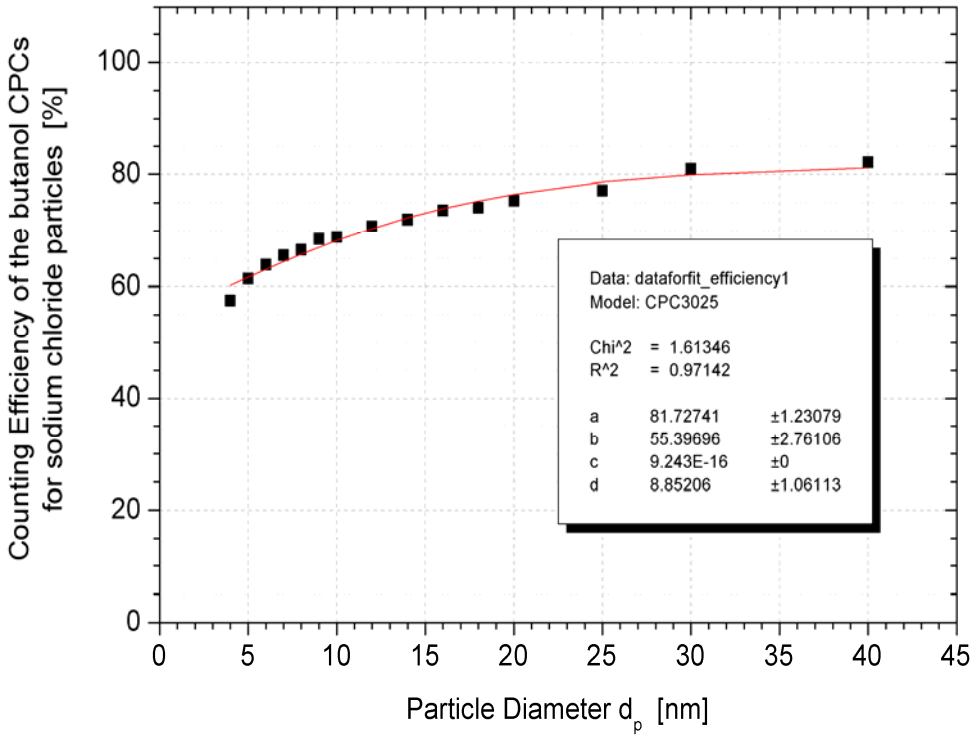
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: CPC3025
Chi^2 = 1.61346
R^2 = 0.97142
a 81.72741 ±1.23079
b 55.39696 ±2.76106
c 9.243E-16 ±0
d 8.85206 ±1.06113

Fig. 26

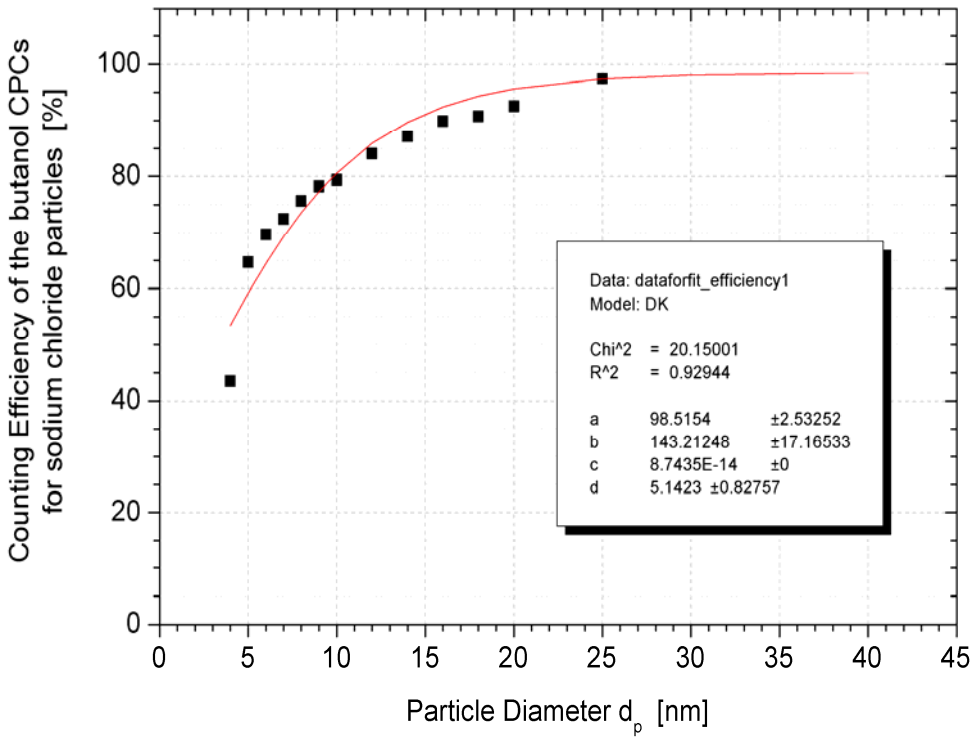
Counting Efficiency of the butanol CPCs for sodium chloride particles [%]
Particle Diameter d_p [nm]
Data: dataforfit_efficiency1
Model: DK
Chi^2 = 20.15001
R^2 = 0.92944
a 98.5154 ±2.53252
b 143.21248 ±17.16533
c 8.7435E-14 ±0
d 5.1423 ±0.82757

Fig. 27