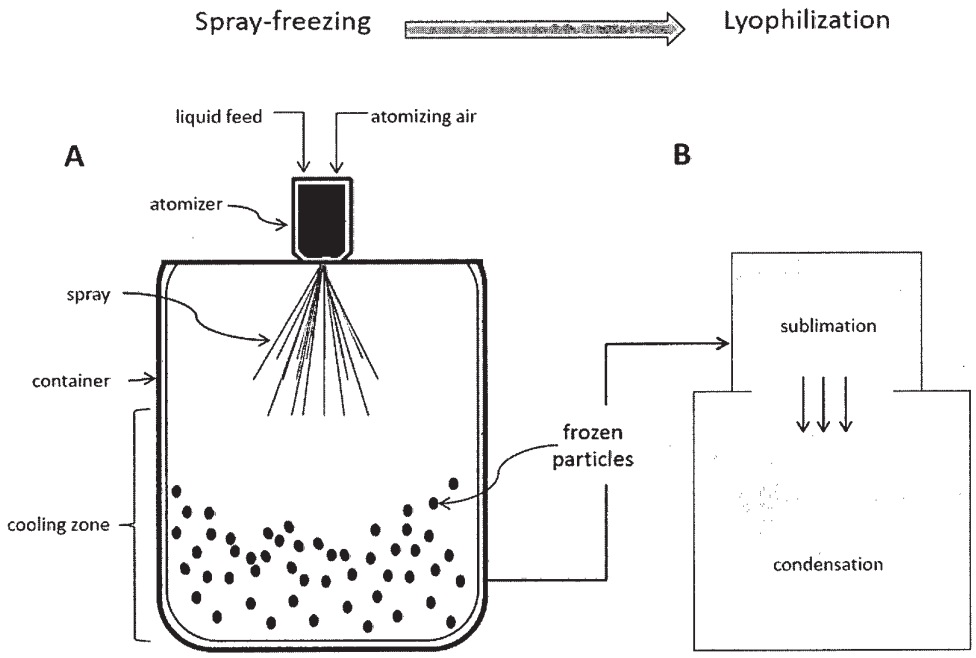
Spray-freezing
Lyophilization
liquid feed
atomizing air
A
B
atomizer
spray
container
cooling zone
frozen particles
sublimation
condensation

Fig. 1

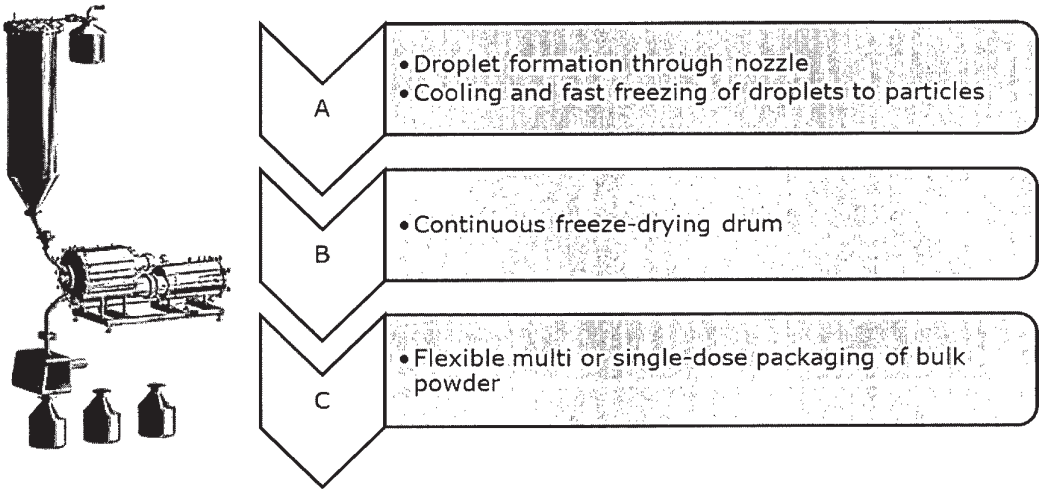
A
• Droplet formation through nozzle
• Cooling and fast freezing of droplets to particles
B
• Continuous freeze-drying drum
C
• Flexible multi or single-dose packaging of bulk powder

Fig. 2

R2564 (SEQ ID NO: 1)

GGGGCGCUGCCUACGGAGGUGGCAGCCAUCUCCUUCUCGGCAUCAAGCUUACCAUGAAGG
CCAUCCUGGUGGUCCUCCUGUACACCUUCGCCACCGCGAACGCCGACACGCUGUGCAUCG
GCUACCACGCCAACAACAGCACCGACACCGUGGACACCGUGCUCGAGAAGAACGUCACGG
UGACCCACUCCGUGAACCUGCUGGAGGACAAGCACAACGGGAAGCUCUGCAAGCUGCGGG
GCGUCGCCCCGCUGCACCUCGGGAAGUGCAACAUCGCCGGCUGGAUCCUGGGGAACCCGG
AGUGCGAGAGCCUGUCCACCGCGAGCUCCUGGAGCUACAUCGUGGAGACCUCCAGCUCCG
ACAACGGCACGUGCUACCCCGGCGACUUCAUCGACUACGAGGAGCUCCGCGAGCAGCUGA
GCUCCGUGAGCUCCUUCGAGCGGUUCGAGAUCUUCCCCAAGACCAGCUCCUGGCCCAACC
ACGACAGCAACAAGGGGGUCACCGCCGCCUGCCCGCACGCCGGCGCGAAGUCCUUCUACA
AGAACCUGAUCUGGCUCGUGAAGAAGGGGAACAGCUACCCCAAGCUGUCCAAGAGCUACA
UCAACGACAAGGGCAAGGAGGUGCUGGUCCUCUGGGGGAUCCACCACCCCAGCACCUCCG
CCGACCAGCAGAGCCUGUACCAGAACGCCGACGCCUACGUGUUCGUGGGCUCCAGCCGCU
ACUCCAAGAAGUUCAAGCCCGAGAUCGCCAUCCGGCCGAAGGUCCGCGACCAGGAGGGCC
GGAUGAACUACUACUGGACGCUGGUGGAGCCCGGGGACAAGAUCACCUUCGAGGCGACCG
GCAACCUCGUGGUCCCCCGCUACGCCUUCGCCAUGGAGCGGAACGCCGGGAGCGGCAUCA
UCAUCUCCGACACCCCCGUGCACGACUGCAACACGACCUGCCAGACCCCGAAGGGCGCCA
UCAACACCAGCCUGCCCUUCCAGAACAUCCACCCCAUCACGAUCGGGAAGUGCCCCAAGU
ACGUGAAGUCCACCAAGCUGCGCCUCGCGACCGGCCUGCGGAACGUCCCGAGCAUCCAGU
CCCGCGGGCUGUUCGGCGCCAUCGCCGGGUUCAUCGAGGGCGGCUGGACCGGGAUGGUGG
ACGGCUGGUACGGGUACCACCACCAGAACGAGCAGGGCAGCGGGUACGCCGCCGACCUCA
AGUCCACGCAGAACGCGAUCGACGAGAUCACCAACAAGGUGAACAGCGUCAUCGAGAAGA
UGAACACCCAGUUCACCGCCGUGGGCAAGGAGUUCAACCACCUGGAGAAGCGGAUCGAGA
ACCUGAACAAGAAGGUCGACGACGGCUUCCUCGACAUCUGGACGUACAACGCCGAGCUGC
UGGUGCUCCUGGAGAACGAGCGCACCCUGGACUACCACGACUCCAACGUGAAGAACCUCU
ACGAGAAGGUCCGGAGCCAGCUGAAGAACAACGCCAAGGAGAUCGGGAACGGCUGCUUCG
AGUUCUACCACAAGUGCGACAACACCUGCAUGGAGUCCGUGAAGAACGGGACCUACGACU
ACCCCAAGUACAGCGAGGAGGCCAAGCUGAACCGCGAGGAGAUCGACGGCGUGAAGCUCG
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UCGUGGUCAGCCUGGGGGCCAUCUCCUUCUGGAUGUGCAGCAACGGCUCCCUGCAGUGCC
GCAUCUGCAUCUGACCACUAGUGCAUCACAUUUAAAAGCAUCUCAGCCUACCAUGAGAAU
AAGAGAAAGAAAAUGAAGAUCAAUAGCUUAUUCAUCUCUUUUUCUUUUUCGUUGGUGUAA
AGCCAACACCCUGUCUAAAAAACAUAAAUUUCUUUAAUCAUUUUGCCUCUUUUCUCUGUG
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Fig. 3

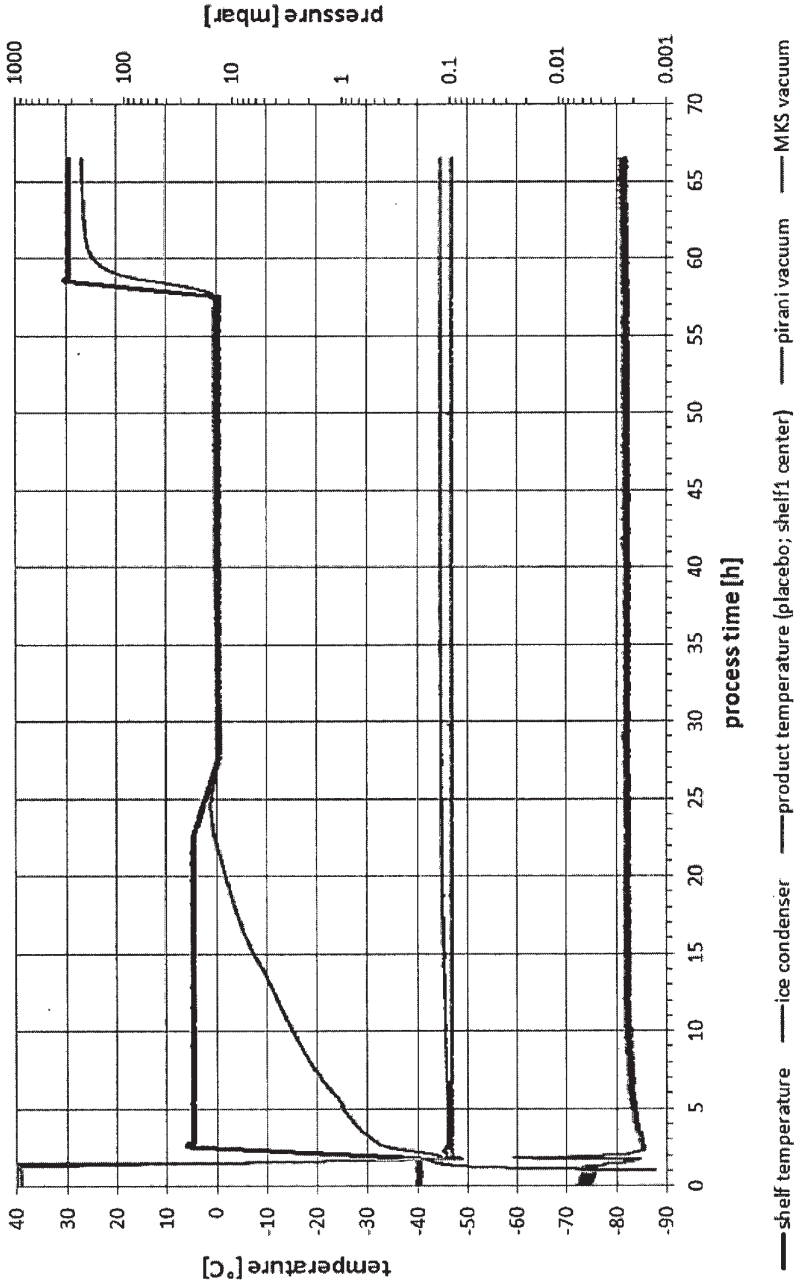
pressure [mbar]
1000
100
10
1
0.1
0.01
0.001
temperature [°C]
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
process time [h]
shelf temperature
ice condenser
product temperature (placebo; shelf1 center)
pirani vacuum
MKS vacuum

Fig. 4


RCC011 Ph8B
T-SFD-P
vial# 5
RCC011 Ph8B
T-SFD2
vial# 15
RCC011 Ph8B
T-SFD1
vial# 8

Fig. 5

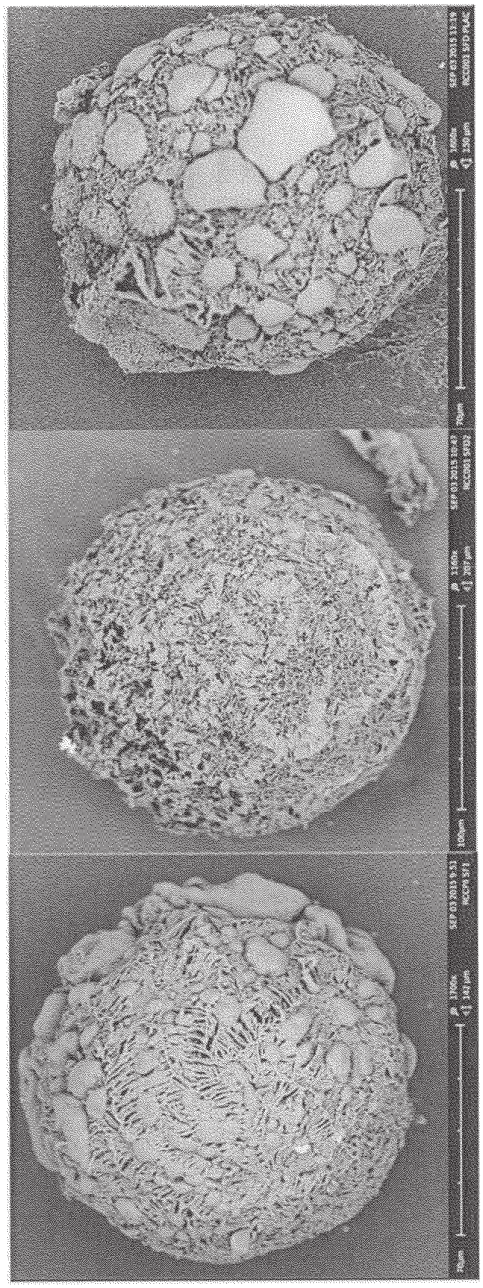

Fig. 6

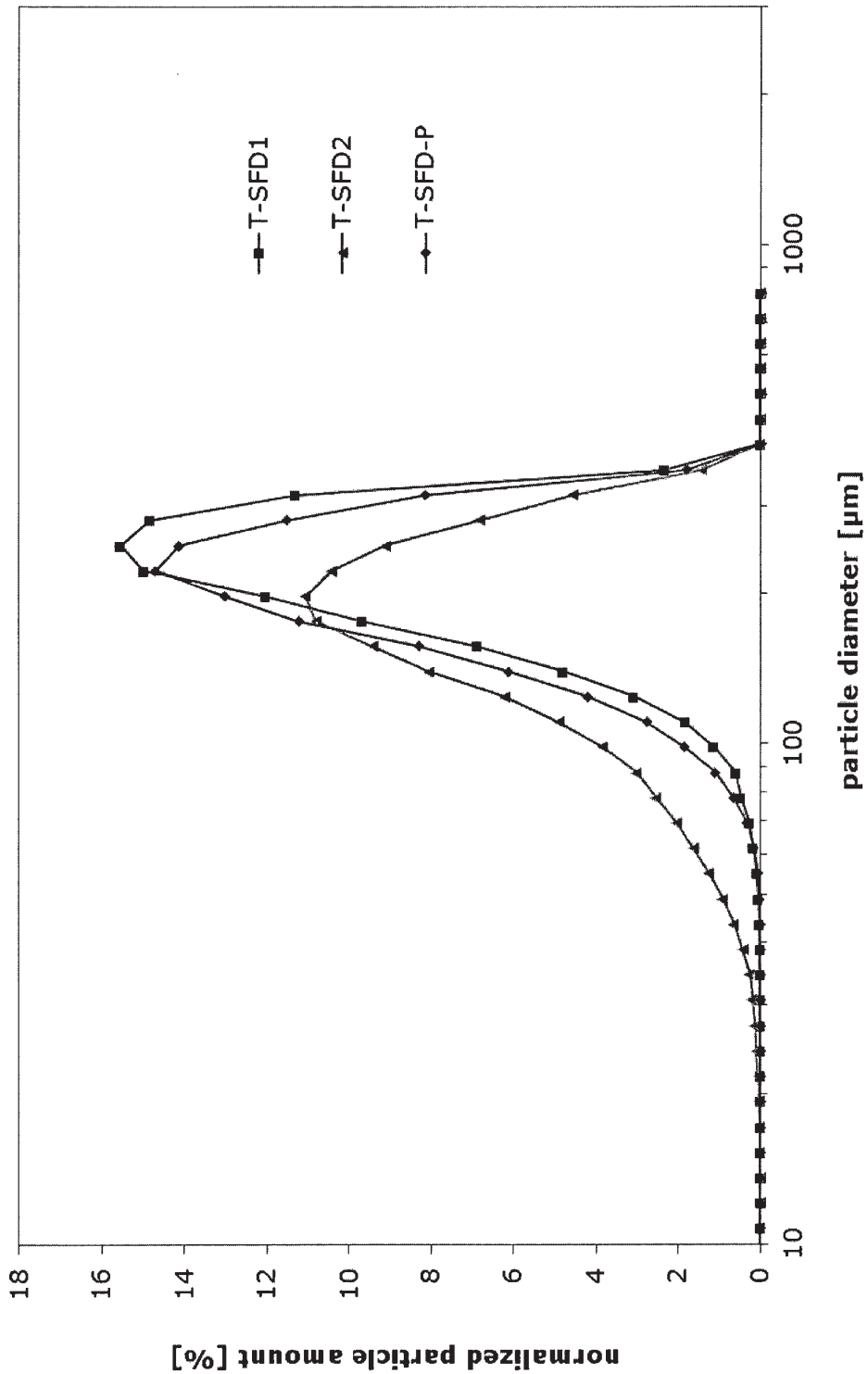
T-SFD1
T-SFD2
T-SFD-P
normalized particle amount [%]
0
2
4
6
8
10
12
14
16
18
10
100
1000
particle diameter [µm]

Fig. 7

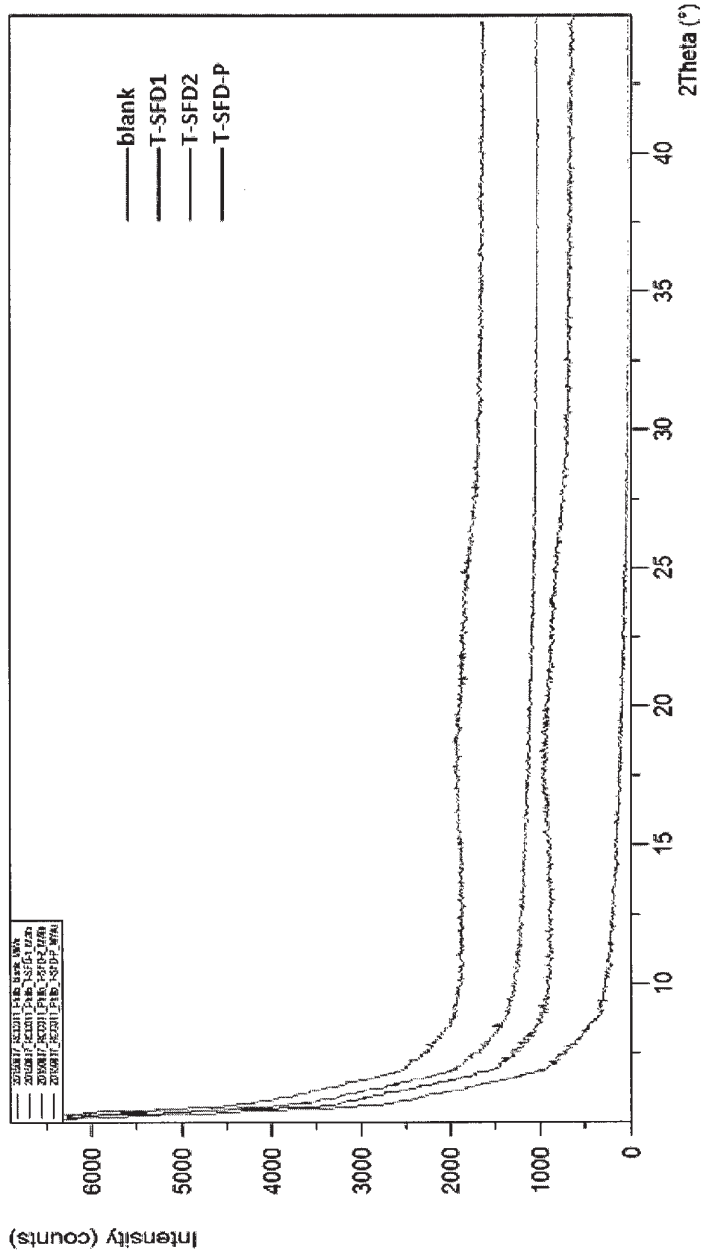
blank
T-SFD1
T-SFD2
T-SFD-P
Intensity (counts)
0
1000
2000
3000
4000
5000
6000
10
15
20
25
30
35
40
2Theta (°)

Fig. 8

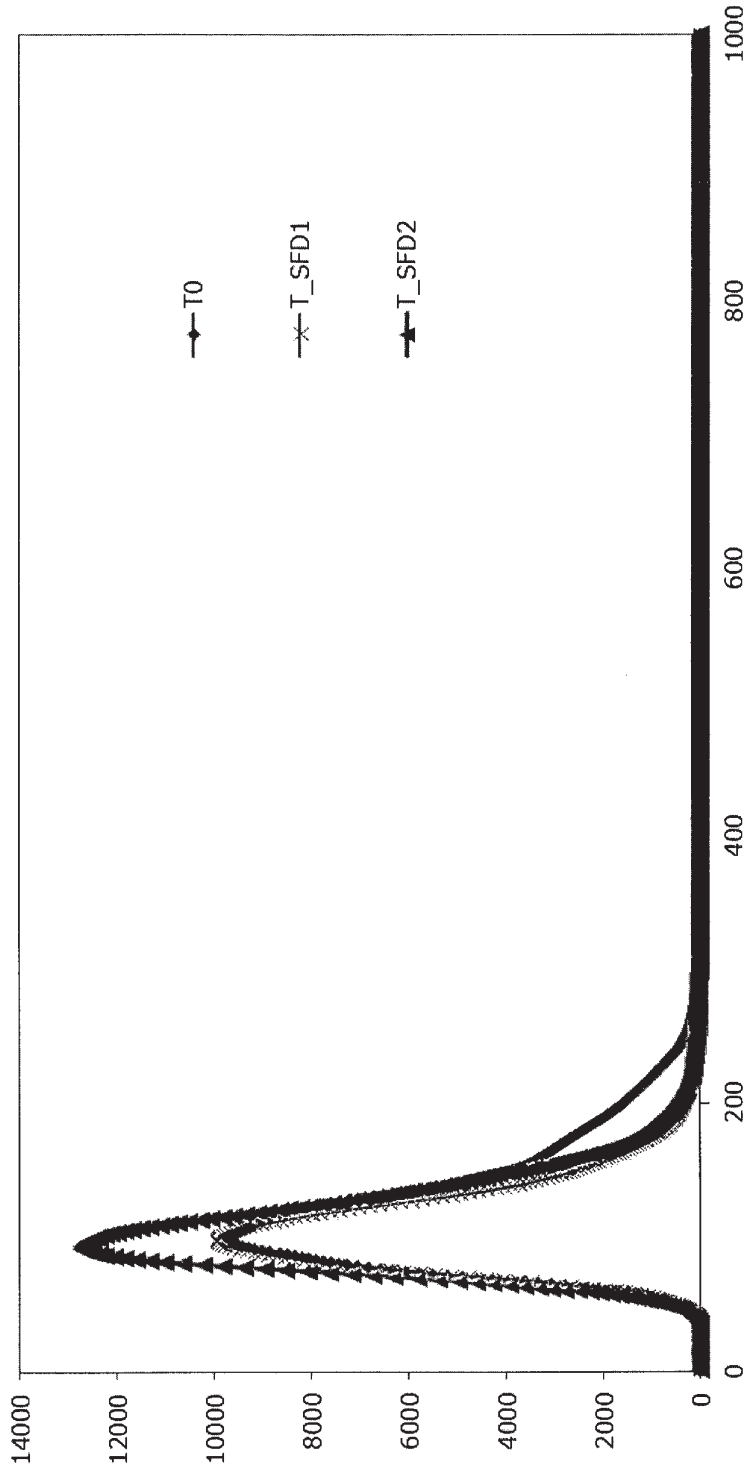
T0
T_SFD1
T_SFD2
14000
12000
10000
8000
6000
4000
2000
0
0
200
400
600
800
1000
Diameter [nm]
Particles per ml [10^6]

Fig. 9

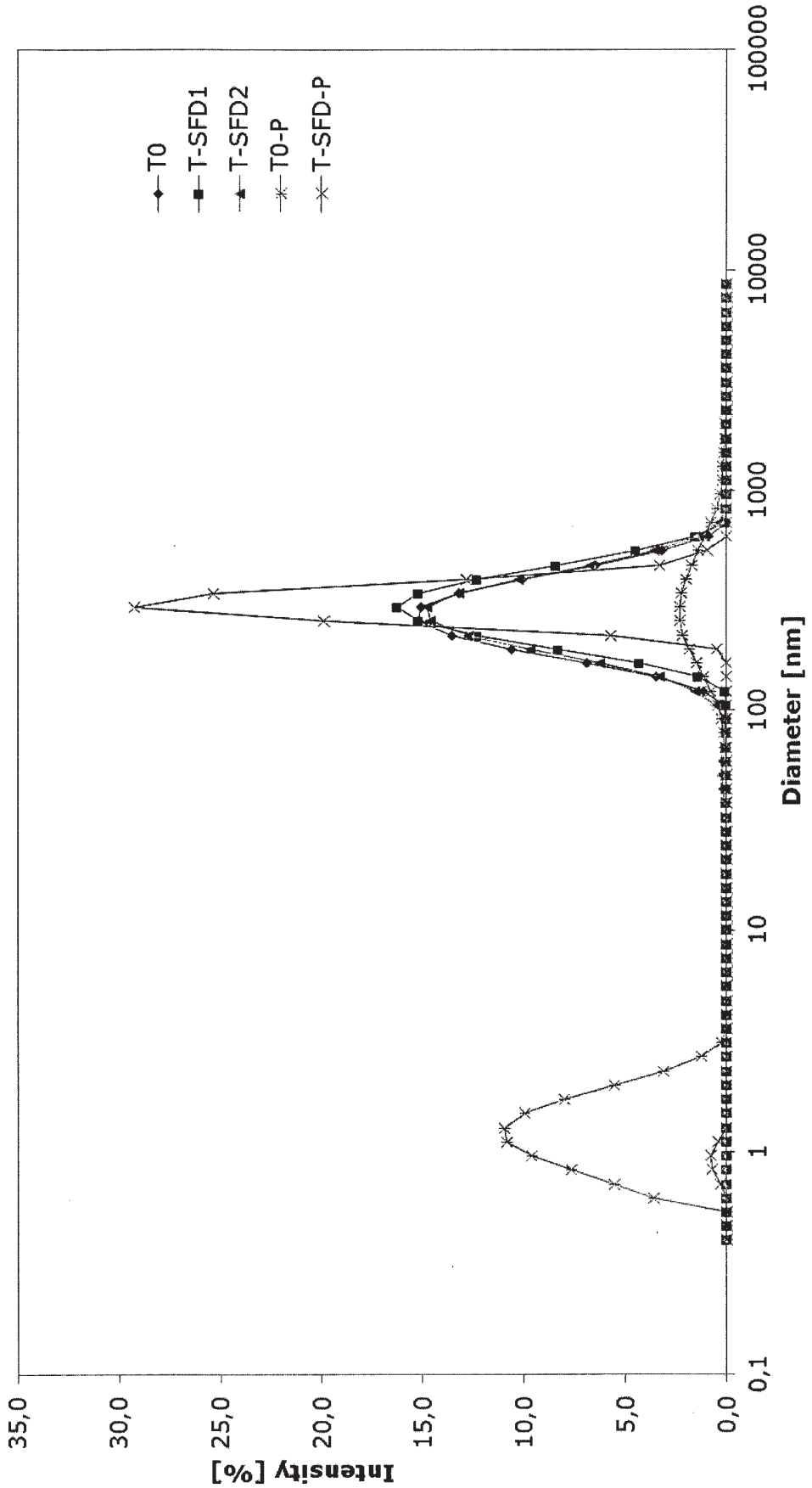
T0
T-SFD1
T-SFD2
T0-P
T-SFD-P
Intensity [%]
35,0
30,0
25,0
20,0
15,0
10,0
5,0
0,0
0,1
1
10
100
1000
10000
100000
Diameter [nm]

Fig. 10