Glass Beads

IFTS tests organized before a Notary

TEST REPORT N. RA_2021_00007015

Determination of the filtration efficiency
and the retention capacity according to NF P 90-319 § 4 with derogations

Domestic swimming pools - Filtration groups and systems - Test methode for evaluating the filtration efficiency, the retention capacity and the mechanical resistance
§4 : Filtration efficiency and retention capacity

Sample ref. Sacs de 20 kg - batch N° 5-6-2018-2 - Glass pearl, Waterco x 3

CUSTOMER IDENTIFICATION	
Company	**NIRVANA Chauffe Piscine**
	QC G8Z 4G3 Trois-Rivières CANADA
Contact	**Mr Martin CARON**
Purchase order nb	P14278

IFTS REFERENCES	
Purchase order nb	ARC_00006372
IFTS Order n.	AFF_00005280
Quotation n.	DEV_00006563.01

Written by
Kevin BARRA

Validated and signed by
Test Manager

REVISION TABLE			
Date	*Version*	*Reason for revision*	*Revision Description*
17/03/2021	RA_2021_00007015	Initial release	

1 - SCOPE

NATURE WORKS TECNOLOGIAS has requested IFTS (Institut de la Filtration et des Techniques Séparatives) as per purchase order number PO acc. to DEV_00006541.01 to evaluate the performance of a specified number of samples according to NF P 90-319 §4 with derogations - Domestic swimming pools - Filtration groups and systems - Test method for evaluating the filtration efficiency, the retention capacity and the mechanical resistance §4 : Filtration efficiency and retention capacity.

The data contained in the following paragraphs establishes the report of the test performed on the sample identified in paragraph 2 of this document. A separate test report is issued for any other test requested as per the purchase order.
This test has been performed with qualified personnel using thoroughly selected equipements in order to comply with test conditions summarized in paragraph 3 of this document. IFTS is accredited by the COFRAC to carry out tests and perform modular activities dealt with by the ISO/IEC 17025.

2 - TEST SAMPLE

Sample ref.	*IFTS ref.*
Sacs de 20 kg - batch N° 5-6-2018-2 - Glass pearl, Waterco x 3	ECH_00038353

Sample ref. : Sacs de 20 kg - batch N° 5-6-2018-2 - Glass pearl, Waterco x 3
supplied by NIRVANA Chauffe Piscine

3- TEST CONDITIONS

3.1 Determination of the filtration efficiency and the retention capacity

The following test conditions have been applied :

- Standard : NF P 90-319 §4 with derogations*
- Multipass circulation of contaminant
- Test liquid : Filtered water
- Temperature : 23°C
- Contaminant : specified according to ISO 12103-1 A4 (ISO CTD)
- Flow velocity : 20 m^3/h.m²
- Test flow rate : 0,37 m^3/h
- Test volume : 41,9 L
- Counting sizes : 1, 2, 5, 10, 20, 30, 40, 50 µm
- Test concentrations : Counting step : 5 mg/L
  Clogging step : 50 mg/L
- On line particle counting

- Test end criteria
  - Final ΔP - Initial ΔP = 500 hPa or
  - Maximal test duration as specified by the customer reached or
  - Upstream pressure

** Derogation in term of fluid circulation (IFTS's pump instead of customer's pump in order to maintain constant flow rate)*

3.2 Test rig

The main pump of the test circuit is installed upstream the tested filter
- Column size H=205 cm ; d=15,4 cm ; Ω=0,0186m²
- Filtration's beds sizes :
  - Glass pearl, Waterco : H=70 cm
  - Support layer supplied by IFTS : H=30 cm
- Backwash procedure :
  - 5 minutes at 30 m^3/h.m^2
    Resulting bed expansion : 10,7%

Fig 1. : Picture of test rig

4- TEST RESULTS

4.1 Test end criteria

	Test end criteria	Actual value	End criteria
Final ΔP - Initial ΔP (hPa)	500	0	NO
Test duration (min)	≥ 360	360	YES

4.2 Filtration performances

Retention capacity at Final ΔP (g)	Filtration ratio 80% (µm)*	Filtration efficiency 45µm (%)*	Comments
78,6	13,67	97,86	/

**Results based on initial efficiency (see comment p.5).*

4.3 Filtration performances

TEST IDENTIFICATION

Test date :	03/02/2021	Operator : ML	IFTS Number : ECH_00038353

FILTER IDENTIFICATION

Sample ref. : Sacs de 20 kg - batch N° 5-6-2018-2 - Glass pearl, Waterco x 3 Tool ref. :

OPERATING CONDITIONS

Test fluid *Type :* Microfiltered water *Temperature (°C) :* 23,1

Initial cleanliness level *Upstream :* 157,0 > 1 µm/mL *Downstream :* 193,5 > 1 µm/mL

Test contaminant *Type :* ISO 12103-1 A4 (ISO CTD) *Batch n. :* 14151C

Fluid circuit

Period	Filter test		Contaminant injection				Particle counting			
	Initial flow rate (L/min)	6,2	Flow rate	Concentration (mg/L)			Counter	Sensor	Flow rate (mL/min)	Volume (mL)
	Test volume (L)	41,91	(L/h)	Initial	Final	Average				
Counting	Concentration (mg/L)	4,9	10,0	197,0	168,8	182,9	PAMAS 2132	Waterviewer	25	25
Clogging		53,0	10,0	2023,0	1924,0	1973,5				

Test parameters evolution (Fig. 5)

TEST RESULTS

Differential pressure at test flow rate

Filter housing (hPa) : <2 *Clean assy (hPa) :* 93

Filtering media (hPa) : 93 *Final filtering media (hPa) :* 93

Table 1 : Clogging curve (Fig. 4)

Period n.	1		2		3		4		5	
Concentration (mg/L)	-	4,9	53,0	4,9	53,0	4,9	53,0	4,9	53,0	4,9
Test duration (min)	0	30	92	123	179	210	270	302	360	392
Differential pressure (hPa)	92	91	91	92	92	93	94	94	93	94
Injected mass (g)	0	0,9	21,3	22,3	40,7	41,6	61,0	62,0	81,1	82,1

Total injected mass : 81,1 g

Final test concentration (CF 1) : 58,9 mg/L

Non-retained mass : 2,5 g

Retention capacity : 78,6 g

- **Filtration term: Pressure Drop**
- **Technical term: Filtering media (hPa)**
- **Calculation: INLET - OUTLET Pressure**
- **Value: 93 hPa**

- **Filtration term: Filtration Performance**
- **Technical term: Retention Capacity %**
- **Calculation: Retention Capacity [78,6 g] / Injected mass [81,1 g] = 0,9964 x 100%**
- **Valor: 96,92 %**

Raw counting results (Fig. 1-2-3) Sample ref. Sacs de 20 kg - batch N° 5-6-2018-2 - Glass pearl, Waterco x 3 (ECH_00038353)

Table 2 : Average filtration ratio and efficiency vs. Test period

Cumulative counts (#/mL)

Particle size (µm) / *Counting period*		*> 1 µm*	*R10 E%*	*> 2 µm*	*R11 E%*	*> 5 µm*	*R12 E%*	*> 10 µm*	*R13 E%*	*> 20 µm*	*R14 E%*	*> 30 µm*	*R15 E%*	*> 40 µm*	*R16 E%*	*> 50 µm*	*R17 E%*
Upstream initial counts		157		108,6		31,26		5,662		0,721		0,16		0,04		0,024	
1	*Upstream*	21201	2,001	14428	2,081	3827	2,427	471,8	3,603	49,7	10,92	12,91	27,47	4,107	45,47	1,624	43,95
	Downstream	10595	50,03	6934	51,94	1576	58,8	130,9	72,25	4,552	90,84	0,47	96,36	0,09	97,8	0,037	97,72
2	*Upstream*	Saturation of counting system															
	Downstream																
3	*Upstream*																
	Downstream																
4	*Upstream*																
	Downstream																
5	*Upstream*																
	Downstream																
Average	*Upstream*																
	Downstream																

During counting period 2, 3, 4, and 5, number of particles is higher than saturation level due to multipass circulation and filter efficiency.

*Note: Efficiency value is rounded to 100% when above 99.995

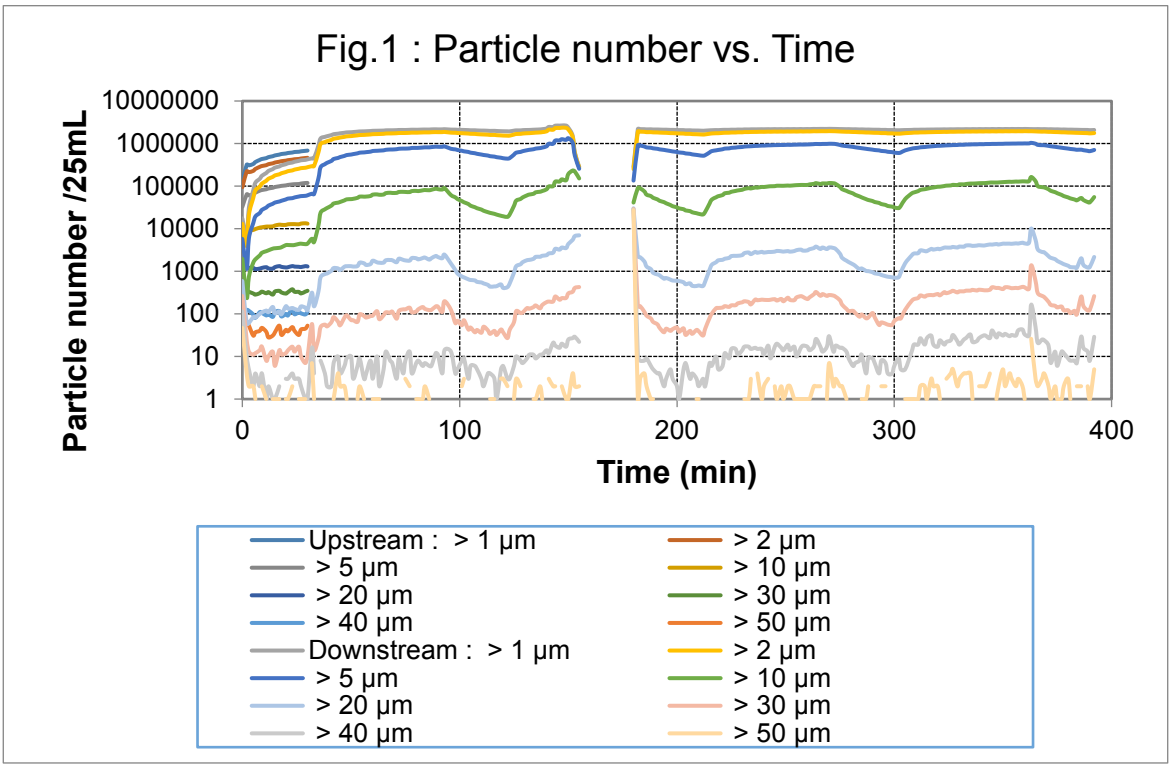
Fig.1 : Particle number vs. Time
Particle number /25mL
10000000
1000000
100000
10000
1000
100
10
1
0
100
200
300
400
Time (min)
Upstream : > 1 µm
> 2 µm
> 5 µm
> 10 µm
> 20 µm
> 30 µm
> 40 µm
> 50 µm
Downstream : > 1 µm
> 2 µm
> 5 µm
> 10 µm
> 20 µm
> 30 µm
> 40 µm
> 50 µm

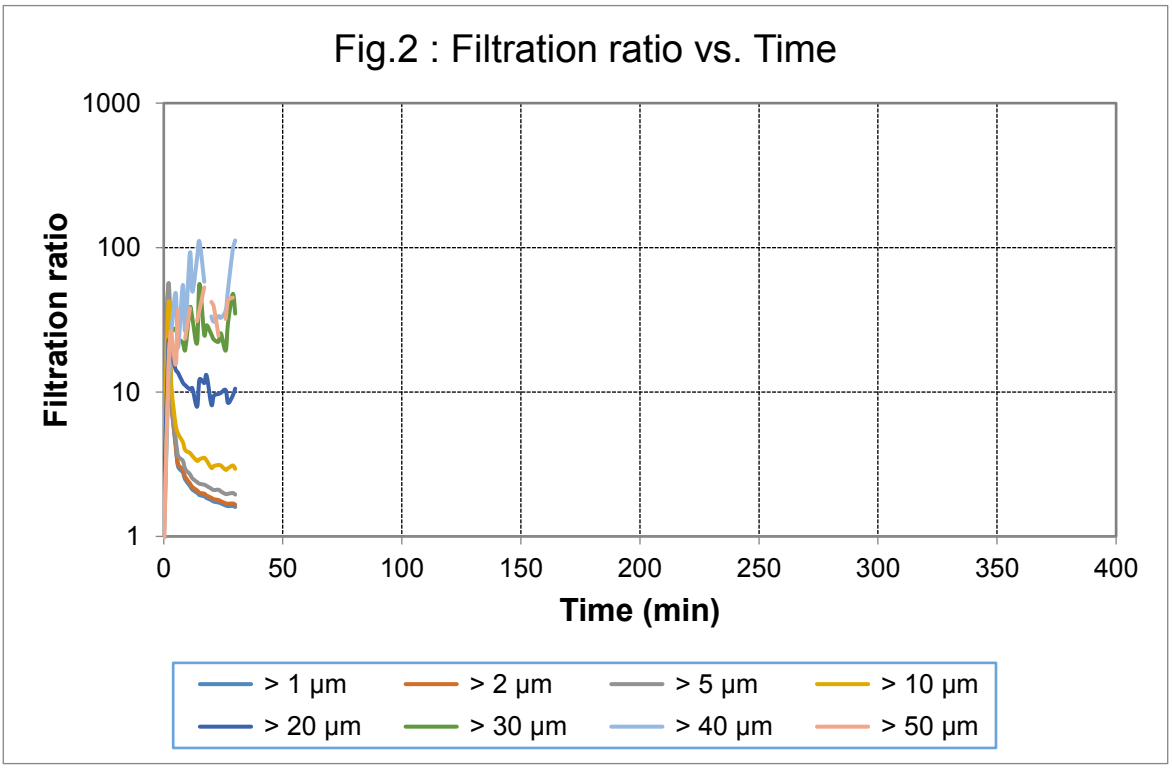
Fig.2 : Filtration ratio vs. Time
Filtration ratio
1000
100
10
1
0
50
100
150
200
250
300
350
400
Time (min)
> 1 µm
> 2 µm
> 5 µm
> 10 µm
> 20 µm
> 30 µm
> 40 µm
> 50 µm

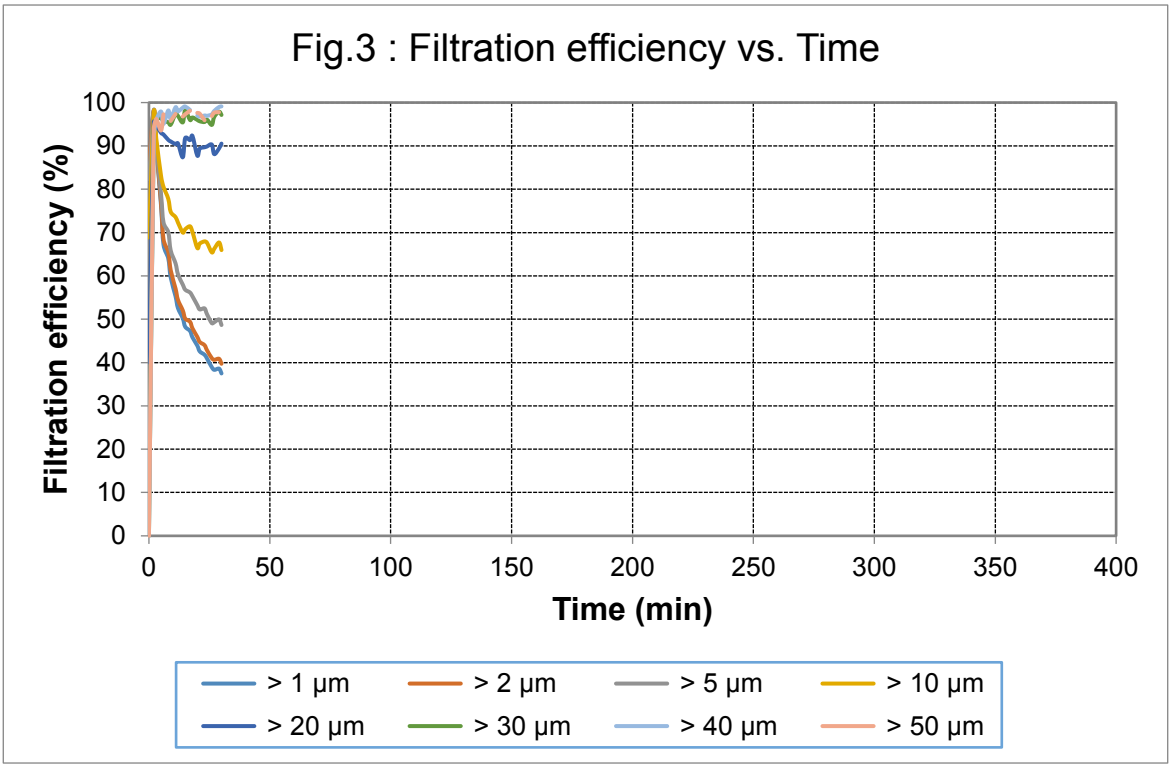
Fig.3 : Filtration efficiency vs. Time
Filtration efficiency (%)
100
90
80
70
60
50
40
30
20
10
0
0
50
100
150
200
250
300
350
400
Time (min)
> 1 µm
> 2 µm
> 5 µm
> 10 µm
> 20 µm
> 30 µm
> 40 µm
> 50 µm

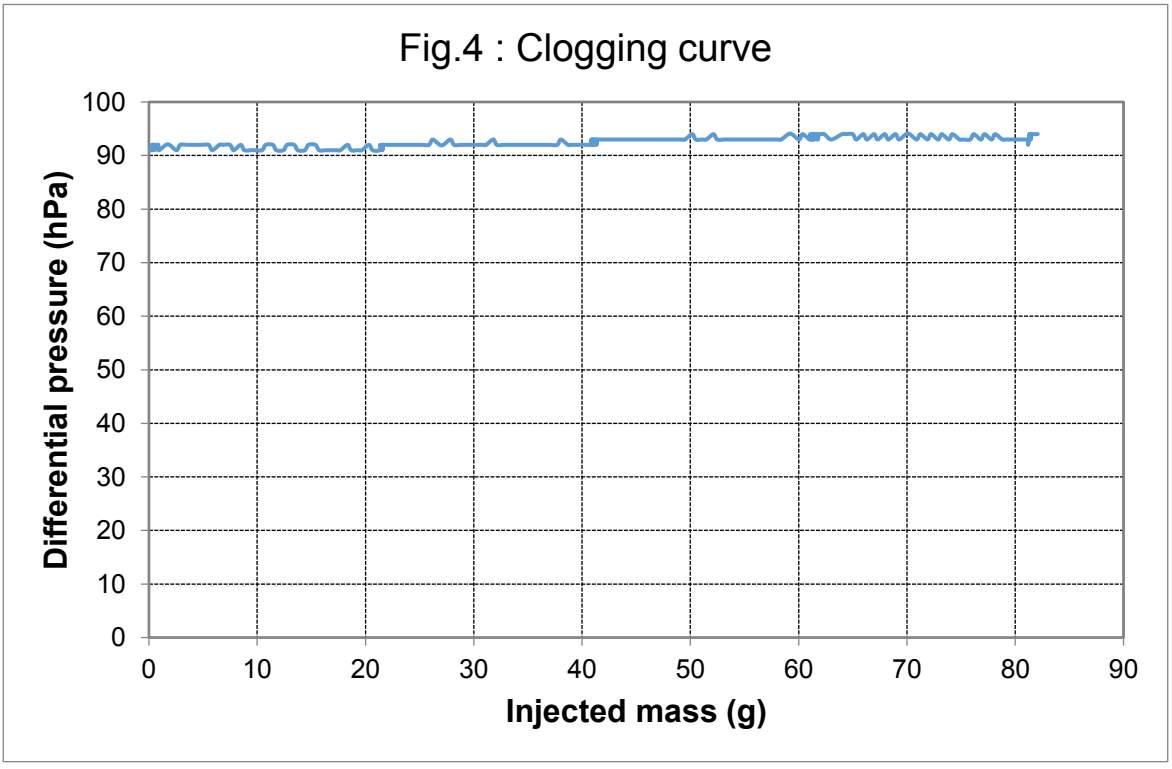
Fig.4 : Clogging curve
Differential pressure (hPa)
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
Injected mass (g)

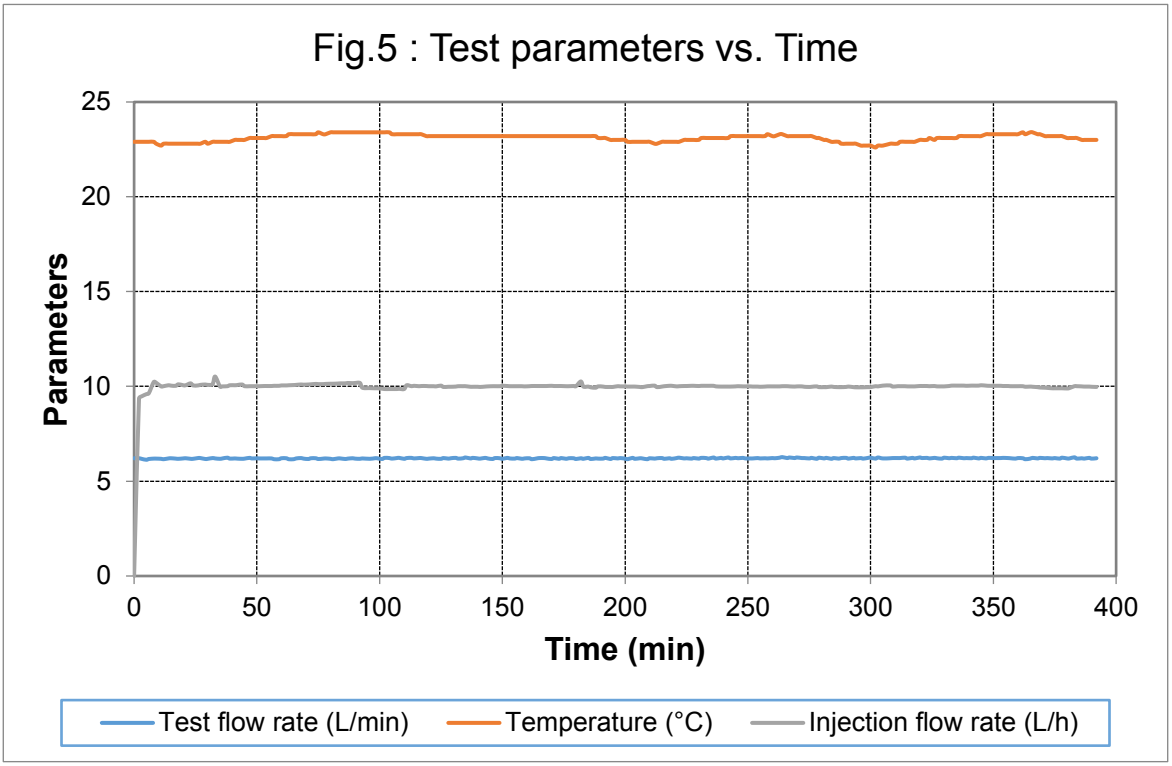
Fig.5 : Test parameters vs. Time
Parameters
25
20
15
10
5
0
0
50
100
150
200
250
300
350
400
Time (min)
Test flow rate (L/min)
Temperature (°C)
Injection flow rate (L/h)

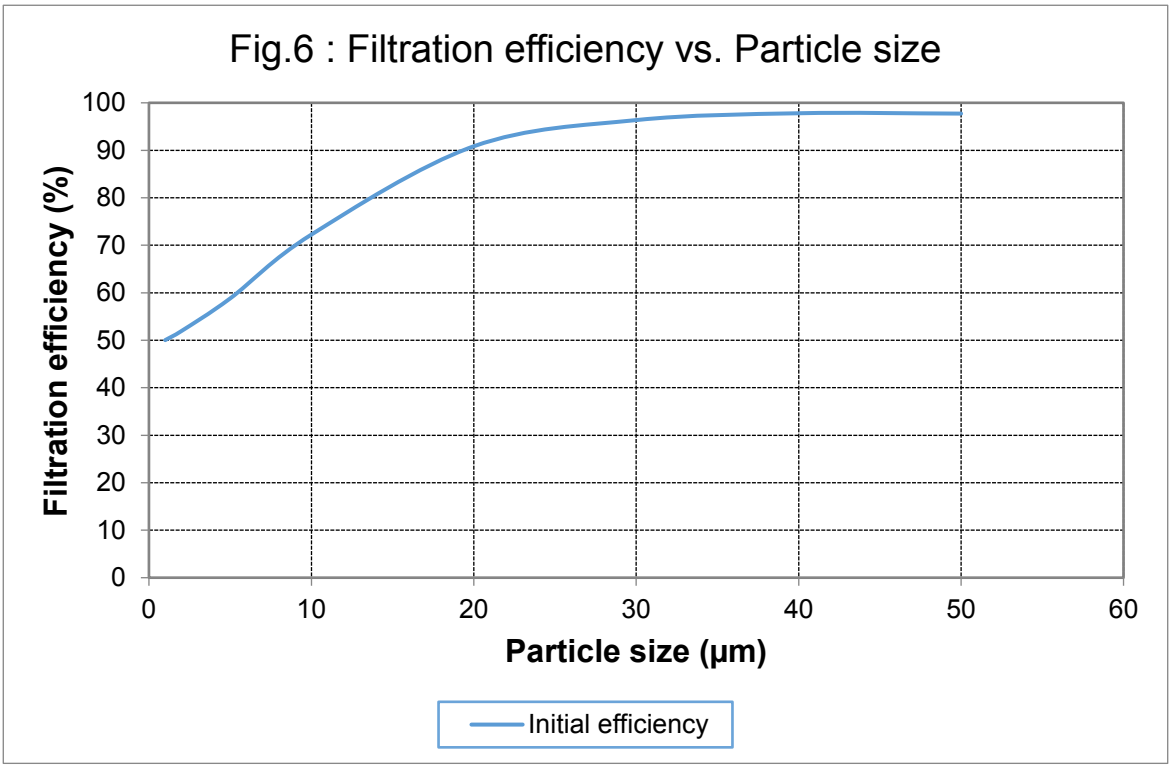
Fig.6 : Filtration efficiency vs. Particle size
Filtration efficiency (%)
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
Particle size (µm)
Initial efficiency