Bio - contamination Control. Four microbiological air samplers comparison

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- Abstract

Four different microbiological air samplers were used at the same time, in the same conditions to evaluate their performances and to demonstrate how the micro-organisms are not even distributed in the environment. The results confirm that: (a) it is not easy to compare the results of different air samplers; (b) the micro-organisms are irregularly distributed in the air.

- Introduction

The new “ISO 14698 Clean Room and Associated Controlled Environments -1:2003” gives detailed Guide lines on the choice and on the performances of a microbiological air sampler. According to this standard, a comparative test was performed using four competitive samplers: Air-Ideal, Centrifugal, MAS 100 and DUO.

- Objective

The objective of this study was to confirm that different air samplers may give different results and to demonstrate how the dispersion of micro-organisms population in air is very irregular and therefore it should be necessary to sample high volumes of air and to calculate an average value adopting multiple sampling in the same site at the same time. This is the reason why it is suggested to adopt a twin heads air sampler.

- Material

“Air-Ideal” sampler

“MAS 100” sampler

Standard disposable 90 mm Petri dishes with Plate Count Agar for “Air-Ideal” and “MAS 100” samplers

“DUO” sampler

Standard 55 mm Contact Plates (RODAC) with Plate Count Agar for “DUO” sampler

“Centrifugal” sampler

Strips with Plate Count Agar for “Centrifugal” sampler.

Duo Sas 360 (International PBI)

- Method

Purpose of this study was to compare 4 microbiological air samplers used to monitor the air contamination in “controlled environments”.
Three different premises were evaluated, each with expected different levels of microbial contamination: (a) room with HEPA filters; (b) a low traffic hallway; (c) a microbiological laboratory. Each site was sampled five times over a period of five days (a working week). The four instruments were positioned on a wheel cart, 40 centimetres apart, used according to the supplier recommendation (Instruction Manual) and all sampling was performed at the same time (every 45 minutes), aspirating 1000 litres of air (1 cubic metre). 1350 tests were performed in total. The incubation of the Petri dishes, Contact Plates and strips was done at 32°C for 48 hours. The result of the counted colonies on agar was expressed as Colony Forming Units (CFU) per 1000 litres (1 cubic meter) of air.

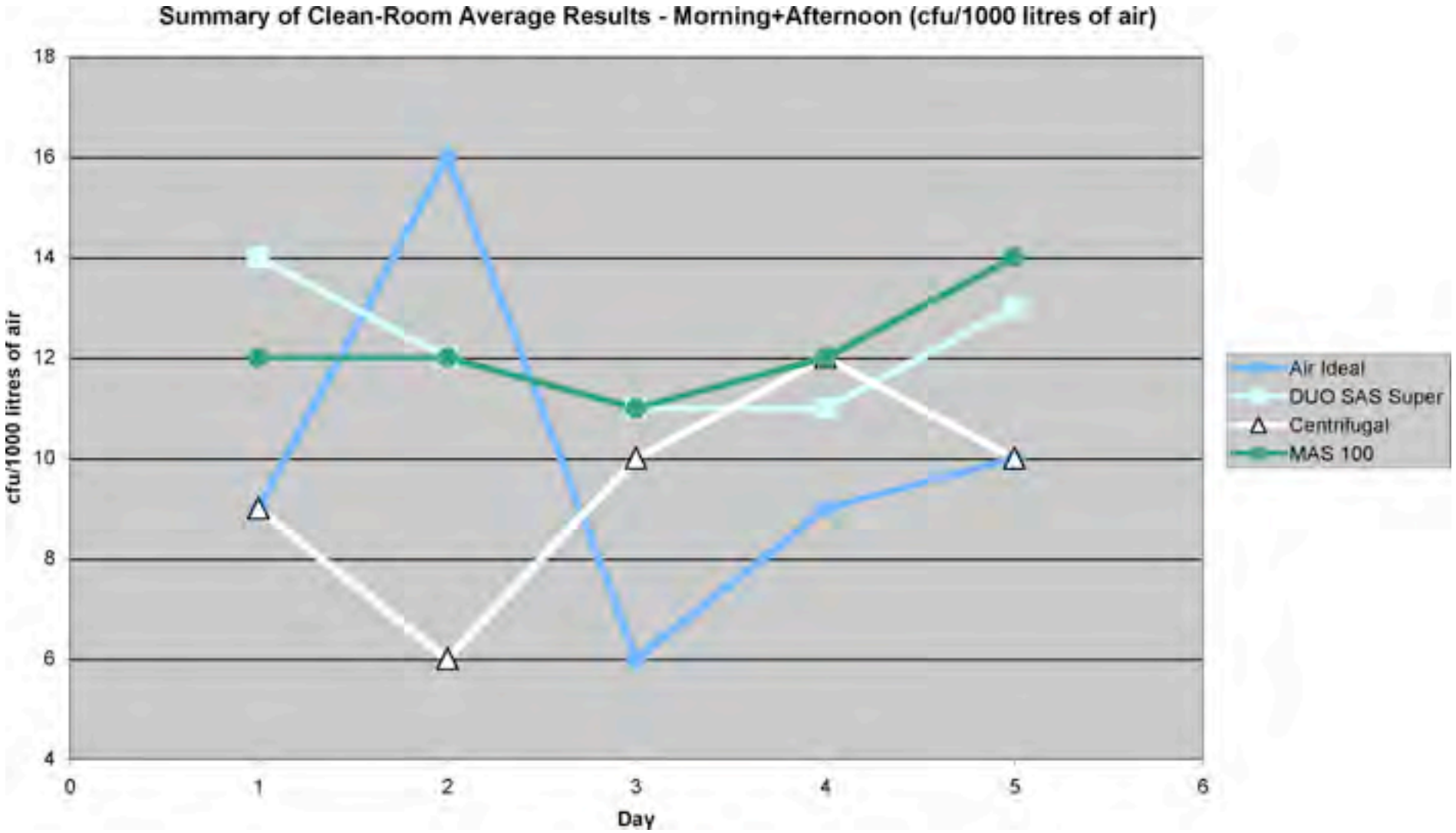
- Results

Clean Room with HEPA filter (CFU/1000 litres of air)

Sampling time	Sampler	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample Average
FIRST DAY							
Morning	Air Ideal	12	6	-	0	9	7
	DUO(l-r)	15/7	22/12	14/25	6/14	13/28	16
	Centrifugal	5	3	1	10	-	5
	MAS 100	2	7	16	10	22	12
Afternoon	Air Ideal	6	15	21	9	2	11
	DUO(l-r)	6/8	17/21	-/-	34/19	28/18	19
	Centrifugal	7	11	9	15	23	13
	MAS 100	12	12	10	8	13	11
SECOND DAY							
Morning	Air Ideal	5	12	1	0	10	6
	DUO(l-r)	12/9	18/11	-/-	21/13	11/17	14
	Centrifugal	12	2	0	7	5	6
	MAS 100	21	12	9	14	12	14
Afternoon	Air Ideal	13	1	7	4	3	6
	DUO(l-r)	21/11	4/8	11/9	17/-	0/13	11
	Centrifugal	0	18	4	1	9	7
	MAS 100	17	10	-	12	8	10
THIRD DAY							
Morning	Air Ideal	7	17	5	1	0	6
	DUO(l-r)	6/17	24/13	6/7	12/4	28/11	13
	Centrifugal	14	16	8	4	-	11
	MAS 100	8	15	11	8	16	10
Afternoon	Air Ideal	9	2	4	8	12	7
	DUO(l-r)	13/7	18/15	6/22	0/-	10/8	10
	Centrifugal	8	16	-	1	10	9
	MAS 100	13	18	7	8	12	12
FOURTH DAY							
Morning	Air Ideal	7	14	0	-	3	6
	DUO(l-r)	3/14	14/22	12/1	21/11	-/-	12
	Centrifugal	16	-	0	12	21	13
	MAS 100	11	10	9	8	5	9
Afternoon	Air Ideal	14	8	9	16	-	12
	DUO(l-r)	14/8	7/21	18/15	2/4	-	12
	Centrifugal	17	8	4	21	9	12
	MAS 100	9	21	15	7	11	11
FIFTH DAY							
Morning	Air Ideal	3	18	21	7	3	11
	DUO(l-r)	-/-	24/5	19/13	12/18	-/19	16
	Centrifugal	9	4	19	21	2	11
	MAS 100	6	22	21	10	11	12
Afternoon	Air Ideal	7	26	3	11	0	9
	DUO(l-r)	14/5	13/24	-/-	6/10	5/25	13
	Centrifugal	12	16	3	7	-	10
	MAS 100	10	14	7	9	11	11

Summary of Clean Room Average Results – Morning + Afternoon (CFU/1000 litres of air)

	AIR IDEAL	**DUO**	**CENTRIFUGAL**	**MAS 100**
1st Day	9	14	9	12
2nd Day	16	12	6	12
3rd Day	6	11	10	11
4th Day	9	11	12	12
5th Day	10	13	10	14

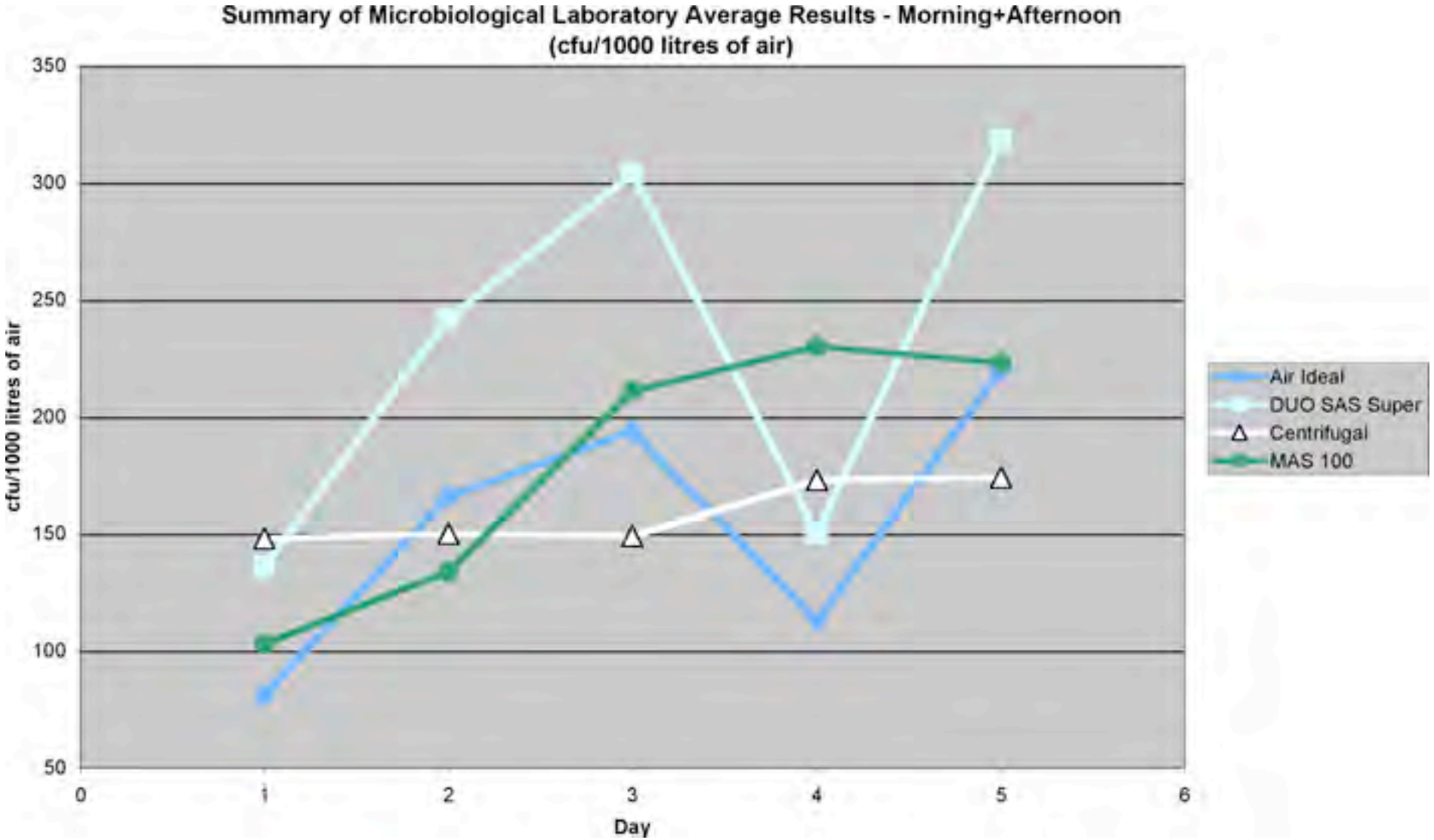

Summary of Clean-Room Average Results - Morning+Afternoon (cfu/1000 litres of air)
cfu/1000 litres of air
18
16
14
12
10
8
6
4
0
1
2
3
4
5
6
Day
Air Ideal
DUO SAS Super
Centrifugal
MAS 100

Microbiological Laboratory (CFU/1000 litres of air)

Sampling time	Sampler	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample Average
FIRST DAY							
Morning	Air Ideal	25	34	73	62	76	54
	DUO(l-r)	54/89	103/45	118/96	198/166	104/188	117
	Centrifugal	98	112	89	166	185	130
	MAS 100	78	95	84	166	102	105
Afternoon	Air Ideal	76	98	55	112	201	109
	DUO(l-r)	122/142	96/86	212/118	104/198	201/271	155
	Centrifugal	110	231	107	89	293	166
	MAS 100	112	90	76	121	108	102
SECOND DAY							
Morning	Air Ideal	118	121	76	226	308	170
	DUO(l-r)	184/145	225/198	256/203	308/156	298/275	218
	Centrifugal	228	143	219	186	244	204
	MAS 100	90	186	212	276	202	194
Afternoon	Air Ideal	201	154	131	204	219	162
	DUO(l-r)	190/216	223/308	-/296	280/207	396/286	267
	Centrifugal	106	-	196	175	-	96
	MAS 100	178	114	185	222	-	175
THIRD DAY							
Morning	Air Ideal	207	154	189	246	205	201
	DUO(l-r)	-/311	344/288	256/198	310/190	-	272
	Centrifugal	306	-	190	-	234	244
	MAS 100	186	216	188	298	194	197
Afternoon	Air Ideal	301	188	156	207	80	187
	DUO(l-r)	338/301	298/367	403/-	-/-	296/344	336
	Centrifugal	238	403	243	176	208	254
	MAS 100	284	-	179	284	154	226
FOURTH DAY							
Morning	Air Ideal	189	107	156	218	-	55
	DUO(l-r)	226/367	-/341	296/243	289/88	196/227	253
	Centrifugal	216	98	101	-	183	150
	MAS 100	313	234	176	202	186	223
Afternoon	Air Ideal	256	176	104	117	207	172
	DUO(l-r)	371/189	159/225	201/278	301/-	-	247
	Centrifugal	184	216	87	301	188	196
	MAS 100	333	210	-	-	167	237
FIFTH DAY							
Morning	Air Ideal	216	188	223	-	197	206
	DUO(l-r)	386/-	207/405	229/334	196/402	-/301	297
	Centrifugal	407	343	185	132	151	244
	MAS 100	276	196	135	227	185	204
Afternoon	Air Ideal	311	-	232	184	202	234
	DUO(l-r)	411/321	376/296	255/317	312/431	-/-	340
	Centrifugal	380	365	276	189	-	305
	MAS 100	-	331	286	164	186	242

Summary of Microbiological Laboratory Average Results – Morning + Afternoon (CFU/1000 litres of air)

	AIR IDEAL	**DUO**	**CENTRIFUGAL**	**MAS 100**
1st Day	81	136	148	103
2nd Day	166	242	150	134
3rd Day	194	304	149	211
4th Day	113	150	173	230
5th Day	220	318	174	223


Summary of Microbiological Laboratory Average Results - Morning+Afternoon
(cfu/1000 litres of air)
cfu/1000 litres of air
350
300
250
200
150
100
50
0
1
2
3
4
5
6
Day
Air Ideal
DUO SAS Super
Centrifugal
MAS 100

Low Traffic hallway (CFU/1000 litres of air)

Sampling time	Sampler	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample Average
FIRST DAY							
Morning	Air Ideal	345	443	298	387	511	397
	DUO(l-r)	490/423	386/456	428/390	608/555	715/604	506
	Centrifugal	316	285	410	390	117	304
	MAS 100	404	326	285	308	514	368
Afternoon	Air Ideal	405	387	453	280	486	403
	DUO(l-r)	467/526	526/438	601/745	649/788	566/643	595
	Centrifugal	518	346	486	524	318	439
	MAS 100	338	-	524	323	312	375
SECOND DAY							
Morning	Air Ideal	455	358	366	298	418	374
	DUO(l-r)	566/444	135/295	495/619	510/529	657/790	504
	Centrifugal	518	622	378	308	780	521
	MAS 100	489	501	364	382	346	416
Afternoon	Air Ideal	396	422	516	304	506	429
	DUO(l-r)	705/556	432/497	316/562	718/643	580/801	581
	Centrifugal	607	453	642	514	-	554
	MAS 100	510	312	401	329	523	415
THIRD DAY							
Morning	Air Ideal	-	-	567	407	432	469
	DUO(l-r)	666/457	722/798	554/653	629/758	734/786	676
	Centrifugal	408	318	586	659	562	507
	MAS 100	567	429	504	432	608	508
Afternoon	Air Ideal	303	452	496	-	392	411
	DUO(l-r)	701/544	643/757	805/799	408/677	678/569	659
	Centrifugal	501	408	-	618	792	580
	MAS 100	614	428	462	502	623	526
FOURTH DAY							
Morning	Air Ideal	567	322	211	456	398	391
	DUO(l-r)	698/590	490/587	-	674/808	715/690	657
	Centrifugal	508	466	-	504	407	476
	MAS 100	608	562	424	626	444	533
Afternoon	Air Ideal	455	329	408	229	418	368
	DUO(l-r)	566/498	718/644	780/-	346/508	715/888	630
	Centrifugal	423	387	415	562	348	427
	MAS 100	486	518	506	442	398	470
FIFTH DAY							
Morning	Air Ideal	600	-	-	455	387	481
	DUO(l-r)	812/710	826/689	-	567/678	-/666	707
	Centrifugal	465	-	566	-	226	419
	MAS 100	448	706	564	428	364	502
Afternoon	Air Ideal	-	459	376	608	289	433
	DUO(l-r)	843/734	842/906	455/675	623/711	-/734	725
	Centrifugal	567	689	455	498	466	535
	MAS 100	754	476	528	322	408	498

Summary of All Trafic Hallway Average Results – Morning + Afternoon (CFU/1000 litres of air)

	AIR IDEAL	DUO	CENTRIFUGAL	MAS 100
1st Day	400	550	371	321
2nd Day	404	544	537	415
3rd Day	440	667	543	517
4th Day	378	643	448	501
5th Day	457	716	477	545


Summary of All Traffic Hallway Average Results - Morning+Afternoon (cfu/1000 litres of air)
cfu/1000 litres of air
750
700
650
600
550
500
450
400
350
300
250
0
1
2
3
4
5
6
Day
Air Ideal
DUO SAS Super
Centrifugal
MAS 100

- Conclusions

The number of micro-organisms that are captured by different air samplers may be quite different due to the fact that each sampler has different constructive characteristics and that the micro-organisms are not evenly distributed in the air. The results of the six tables and three diagrams show that it is necessary to collect a high volume of air and samples should be doubled to calculate an average.

- Bibliography

ISO 14698 Clean Room and Associated Controlled Environments -1:2003 - Bio - contamination Control.