LUFTFLÖDEN I OPERATIONSRUM

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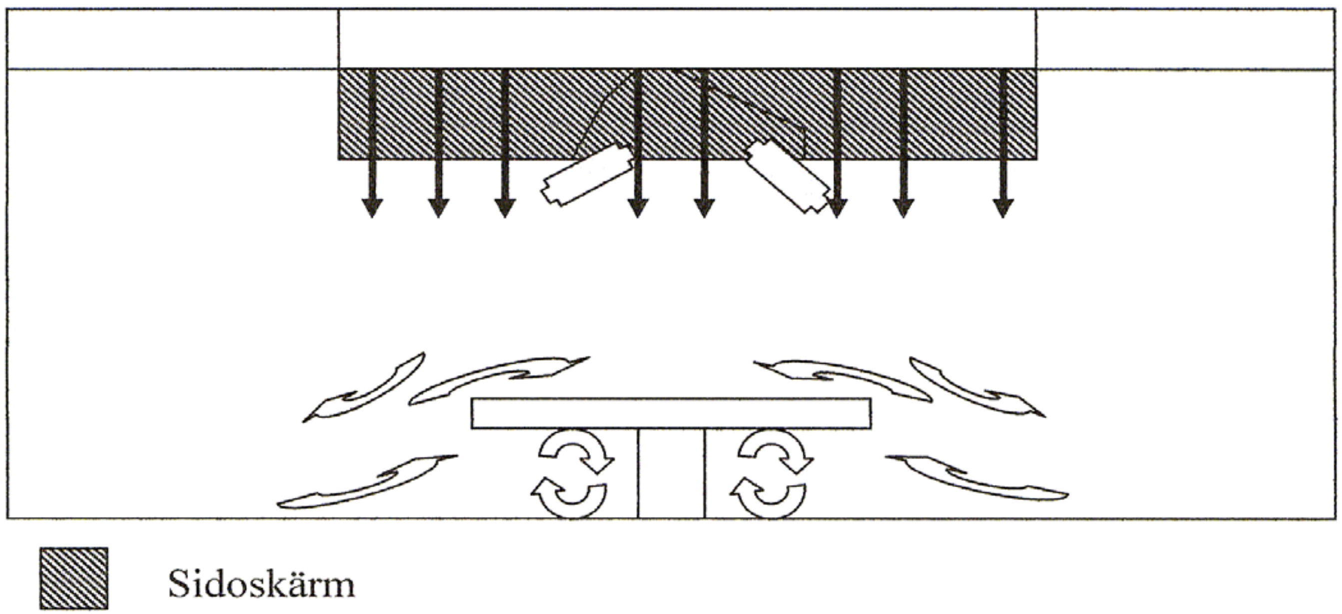
Installationsteknik/Skyddsventilation
Chalmers Göteborg

CHALMERS

OBSERVED AIR MOVEMENTS
Clean zone system with velocity of 0,27 m/s



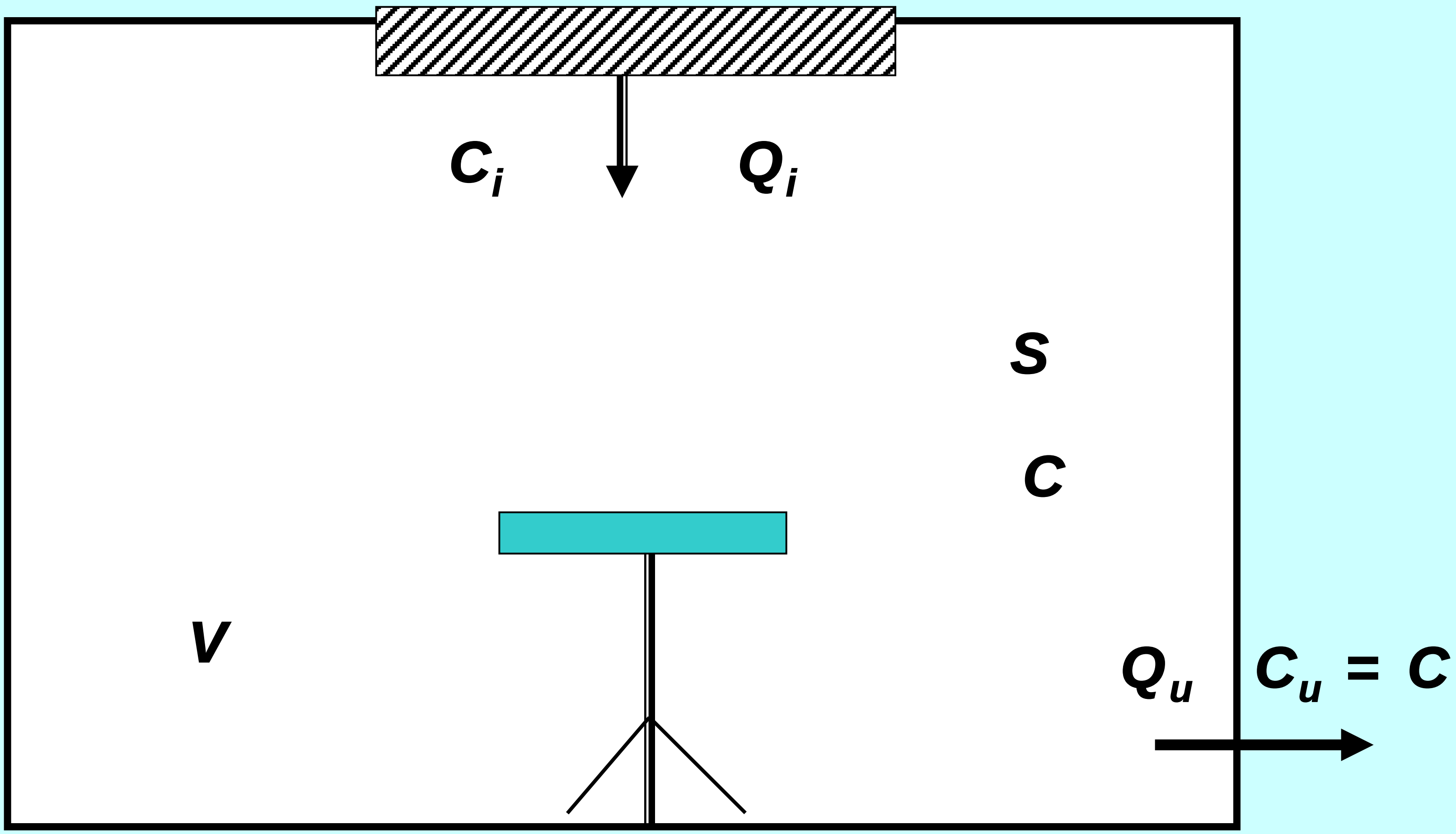
Side screen

Unidirectional air flow

Observed air movements

Operating lamps

Operating room - Principle



Mathematical Expression

$$c = \left(c_o - \frac{S}{Q_m} - c_i \right) e^{-\frac{Q_m}{V} \cdot t} + \frac{S}{Q_m} + c_i$$

Total source strength S can also be expressed as

$$S = n \cdot q_s$$ **(number of bacteria-carrying particles/s)**

Where **n = number of persons (no)**

q_s = source strength for one person (no/s)

Mathematical Expressions

With HEPA-filter $c_i = 0$

Steady state

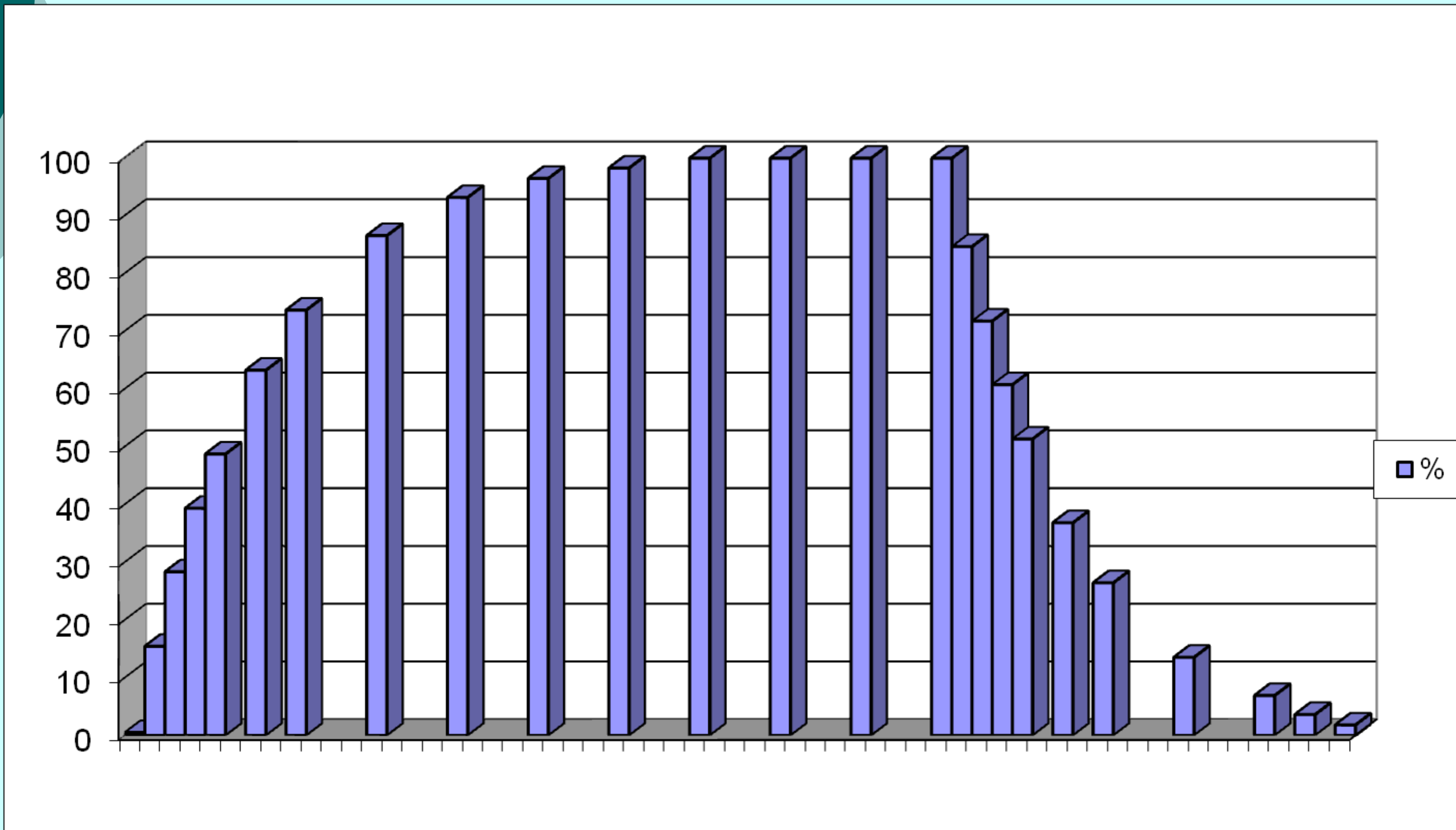
$$c_s = \frac{S}{Q_m} = \frac{n \cdot q_s}{Q_m}$$

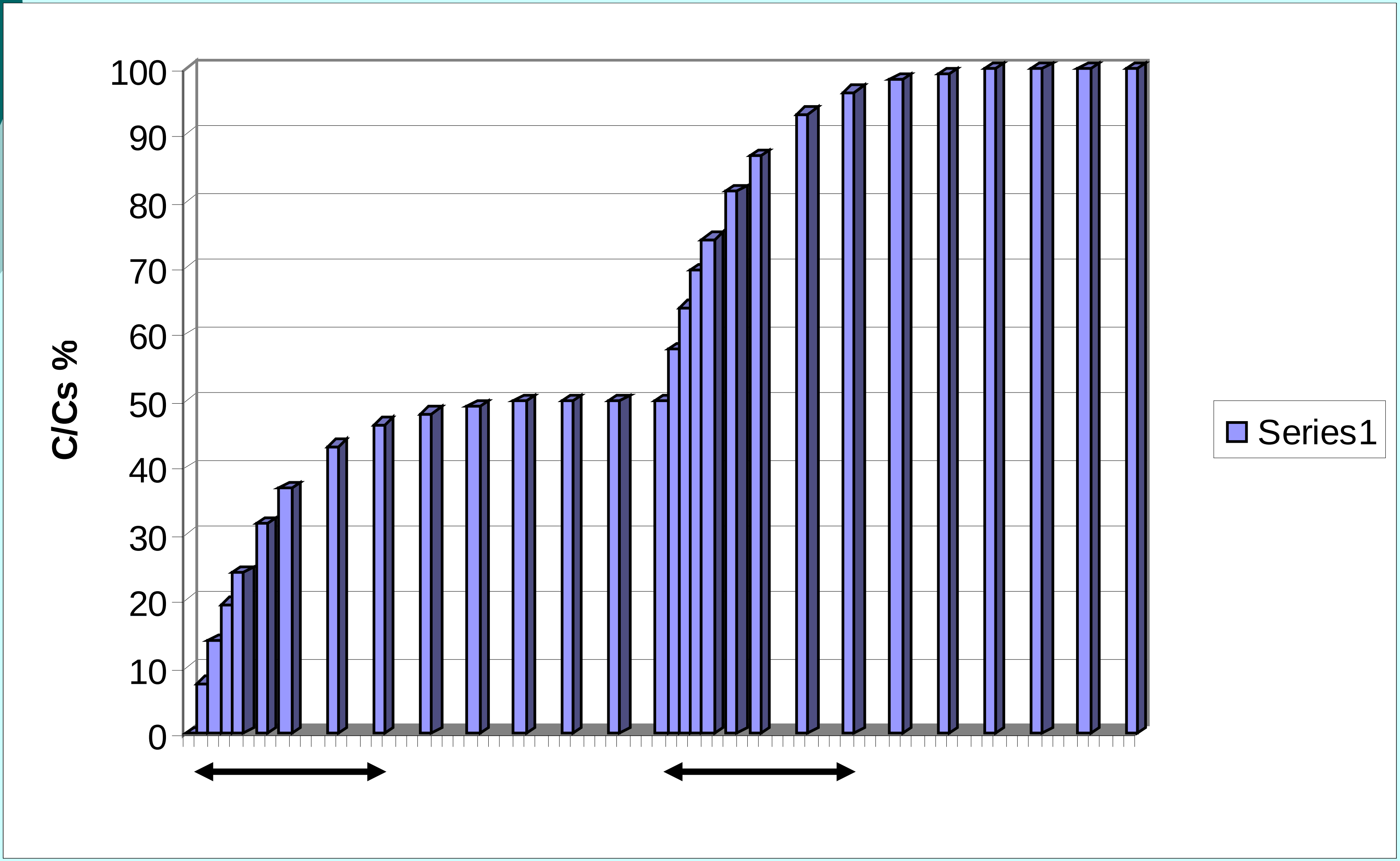
Increase of concentration

$$\frac{c}{c_s} = \left(1 - e^{-\frac{Q_m}{V} \cdot t}\right)$$

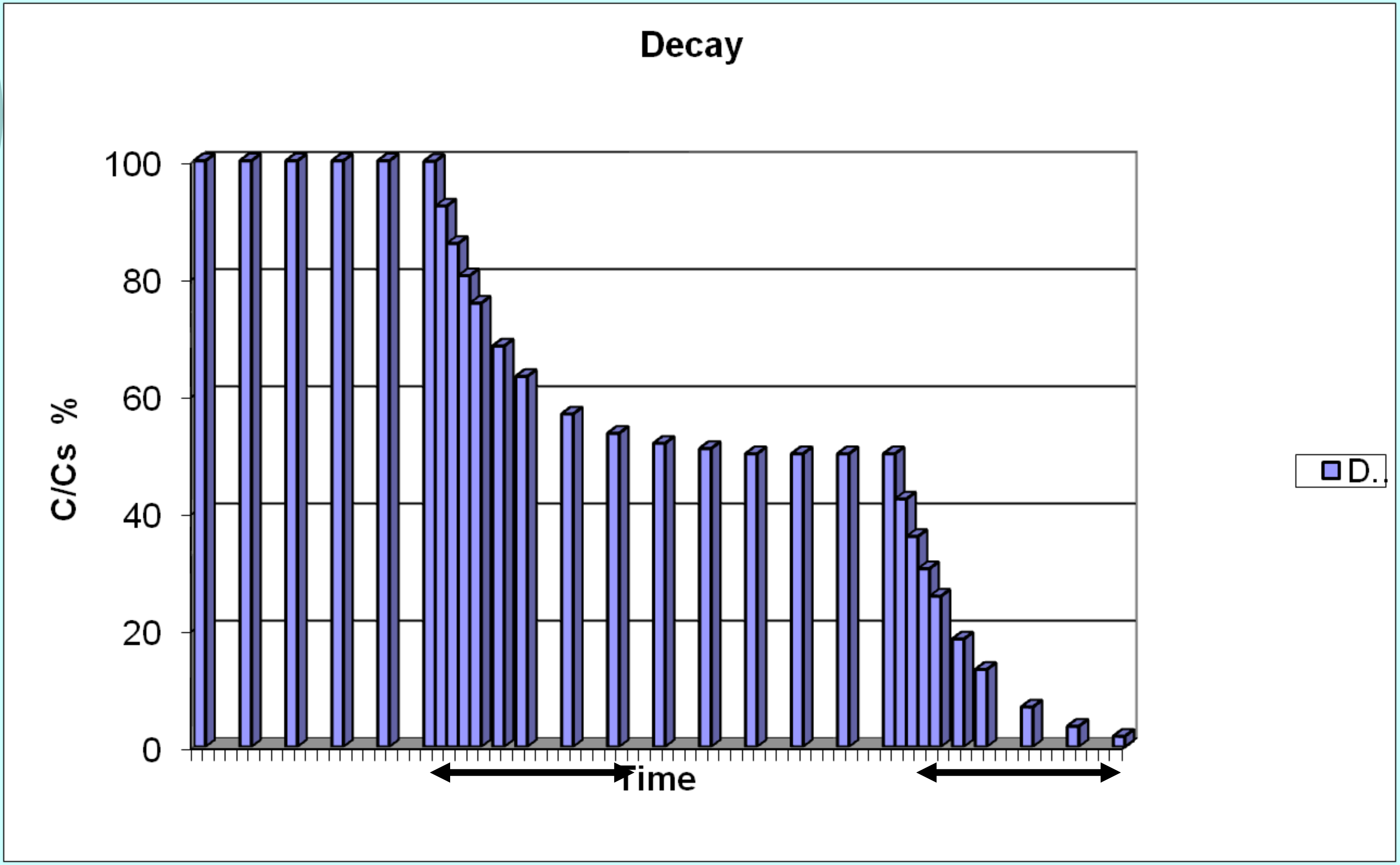
Decrease of concentration

$$\frac{c}{c_s} = e^{-\frac{Q_m}{V} \cdot t}$$


100
90
80
70
60
50
40
30
20
10
0
%



C/Cs %
100
90
80
70
60
50
40
30
20
10
0
Series1


Decay
C/Cs %
100
80
60
40
20
0
Time
D..

Some definitions

Air (volume) flow:

Amount of air per unit time, usually in l/s, m^3/s or m^3/h

Air change rate, *N*;

$$N = \frac{Q}{V}$$

, usually in number of air changes/h

where	Q	=	**air volume flow, m^3/h**
	V	=	**room volume, m^3**

Some definitions

Concentration:

Concentration, *c*, in a room with turbulent mixing air

$$c = \frac{S}{Q}$$ **, (steady state)**

where *S* = total source strength; number /s

$$c = \frac{S}{Q} = \frac{n \cdot q_s}{N \cdot V}$$

Example

Two operating rooms have the same air change rate of 20 air changes per hour and the same source strength from the operating team of 12 CFU/s. The volume of the rooms are 90 m^3 and 120 m^3, respectively. Calculate the theoretical CFU concentration at steady state, when the air movements are turbulent mixing.

$$N = 20 \text{ ac/h} = 20/3600 \text{ ac/s}$$

Room 1:

$$Q_1 = N \times V_1 = 20 \times 90/3600 = 0.5 \text{ m}^3\text{/s}$$

$$c_1 = S/Q_1 = 12/0.5 = 24 \text{ CFU/ m}^3$$

Room 2:

$$Q_2 = N \times V_2 = 20 \times 120/3600 = 2/3 = 0.67 \text{m}^3\text{/s}$$

$$c_2 = S/Q_2 = 12/0.67 = 18 \text{ CFU/ m}^3$$

Conclusion

At the same level of source strength in rooms with turbulent mixing air;

- **The same air change rate doesn't always give the same concentration (at steady state)**

- **But the same amount of air flow give the same concentration (at steady state)**