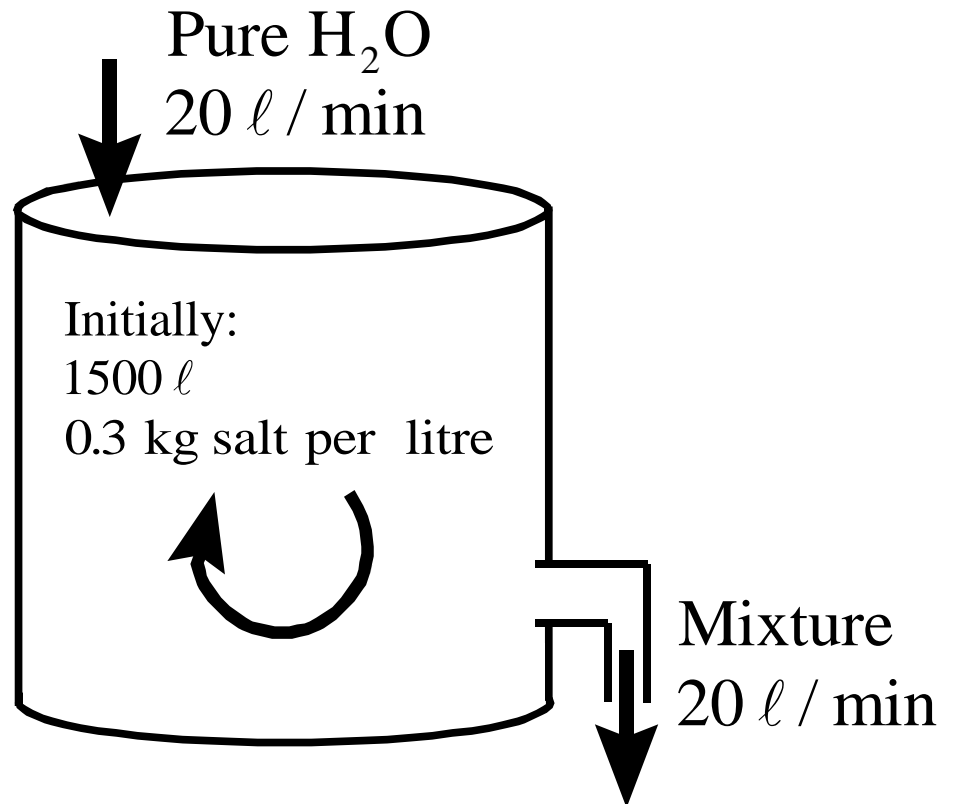


2.7: Toepassing 5: Mengsels (p 21, 76, 77)

2.7: Application 5: Mixtures (p 21, 76, 77)

VOORBEELD 1: 'n Tenk (met 1500 liter soutwater) bevat 'n konsentrasie van 0.3 kg sout per liter. Om die konsentrasie te verdun word suiwer water bygevoeg teen 20 liter/minuut. Die mengsel word goed geroer en verlaat die tenk teen 20 liter/minuut. Bepaal die konsentrasie sout in die tenk op enige tydstip t . **EXAMPLE 1:** A tank (with 1500ℓ salt water) contains a concentration of 0.3 kg salt per litre. In order to dilute the concentration, pure water is added at 20 ℓ/minute. The mixture is stirred well and exits the tank at 20 ℓ/minute. Determine the concentration salt in the tank at any time t .





(1) Aanname

**Tempo waarteen massa
sout in tenk toeneem**

*Rate at which mass of
salt in tank **increases***

=

**Tempo waarteen
massa sout ingaan**

*Rate at which mass
of salt enters tank*

-

**Tempo waarteen
massa sout uitgaan**

*Rate at which mass
of salt exits tank*

(1) Assumption



(1) Aanname

Tempo waarteen massa
sout in tenk toeneem

*Rate at which mass of
salt in tank increases*

=

Tempo waarteen
massa sout ingaan

*Rate at which mass
of salt enters tank*

-

Tempo waarteen
massa sout uitgaan

*Rate at which mass
of salt exits tank*

(1) Assumption

(2) Wiskundige formulering

Laat $m = m(t)$ die massa sout in die tenk op 'n tydstep t wees (t in minute)

Let $m = m(t)$ be the mass of the salt in the tank at time t (in minutes)

$$\frac{dm}{dt} = 0 - \frac{m}{1500} \quad (20)$$

$$\Rightarrow \frac{dm}{dt} = -\frac{1}{75}m$$

$$m(0) = m_0 = 0.3\text{kg}/\ell \times 1500\ell = 450\text{kg}$$

(2) Mathematical formulation

(maak seker dat eenhede links en
regs ooreenstem)

(make sure that the units, left & right,
correspond)



(1) Aanname

(1) Assumption

Tempo waarteen massa sout in tenk toeneem = Tempo waarteen massa sout ingaan - Tempo waarteen massa sout uitgaan

Rate at which mass of salt in tank **increases** = Rate at which mass of salt enters tank - Rate at which mass of salt exits tank

(2) Wiskundige formulering

(2) Mathematical formulation

Laat $m = m(t)$ die massa sout in die tenk op 'n tydstep t wees (t in minute)

Let $m = m(t)$ be the mass of the salt in the tank at time t (in minutes)

$$\frac{dm}{dt} = 0 - \frac{m}{1500}(20)$$

$$\Rightarrow \frac{dm}{dt} = -\frac{1}{75}m$$

(maak seker dat eenhede links en regs ooreenstem)

(make sure that the units, left & right, correspond)

$$m(0) = m_0 = 0.3\text{kg}/\ell \times 1500\ell = 450\text{kg}$$

(3) Verkry oplossings →

$$m(t) = 450e^{-\frac{1}{75}t}$$

← **(3) Obtain solutions**

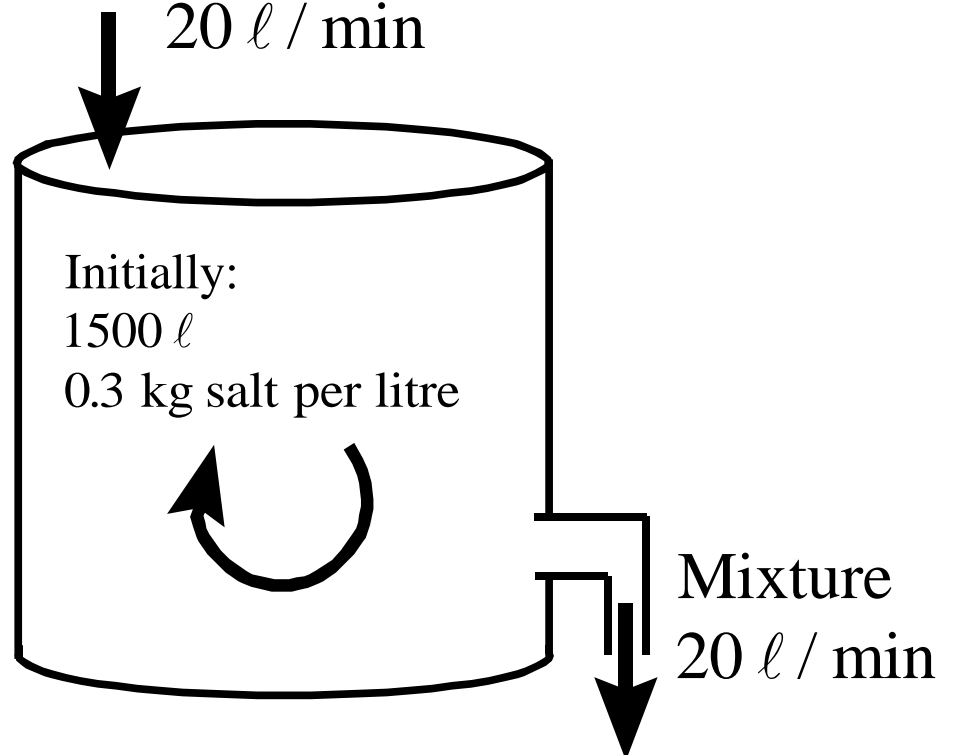
Konsentrasie / Concentration: $c(t) = m(t)/1500 = \frac{450}{1500}e^{-\frac{1}{75}t} = 0.3e^{-\frac{1}{75}t}$

VOORBEELD 2: 'n Tenk (met 1500 liter soutwater) bevat 'n konsentrasie van 0.3 kg sout per liter. Om die konsentrasie te verdun word soutwater (met 'n konsentrasie van 0.1 kg sout per liter) bygevoeg teen 20 liter/minuut. Die mengsel word goed geroer en verlaat die tenk teen 20 liter/minuut. Bepaal die konsentrasie sout in die tenk op enige tydstip t .

EXAMPLE 2: A tank (with 1500ℓ salt water) contains a concentration of 0.3 kg salt per litre. In order to dilute the concentration, salt water (with a concentration of 0.1 kg salt per litre) is added at 20 ℓ/minute. The mixture is stirred well and exits the tank at 20 ℓ/minute. Determine the concentration salt in the tank at any time t .

Mixture (0.1 kg salt per litre)

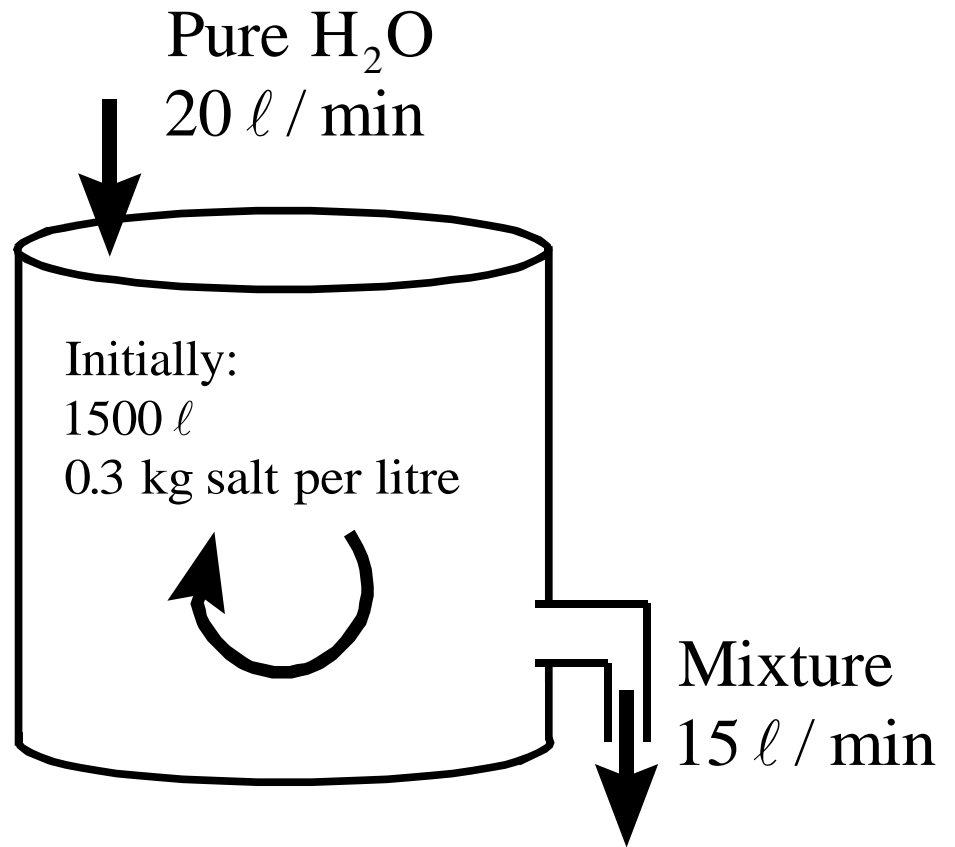
20 ℓ / min



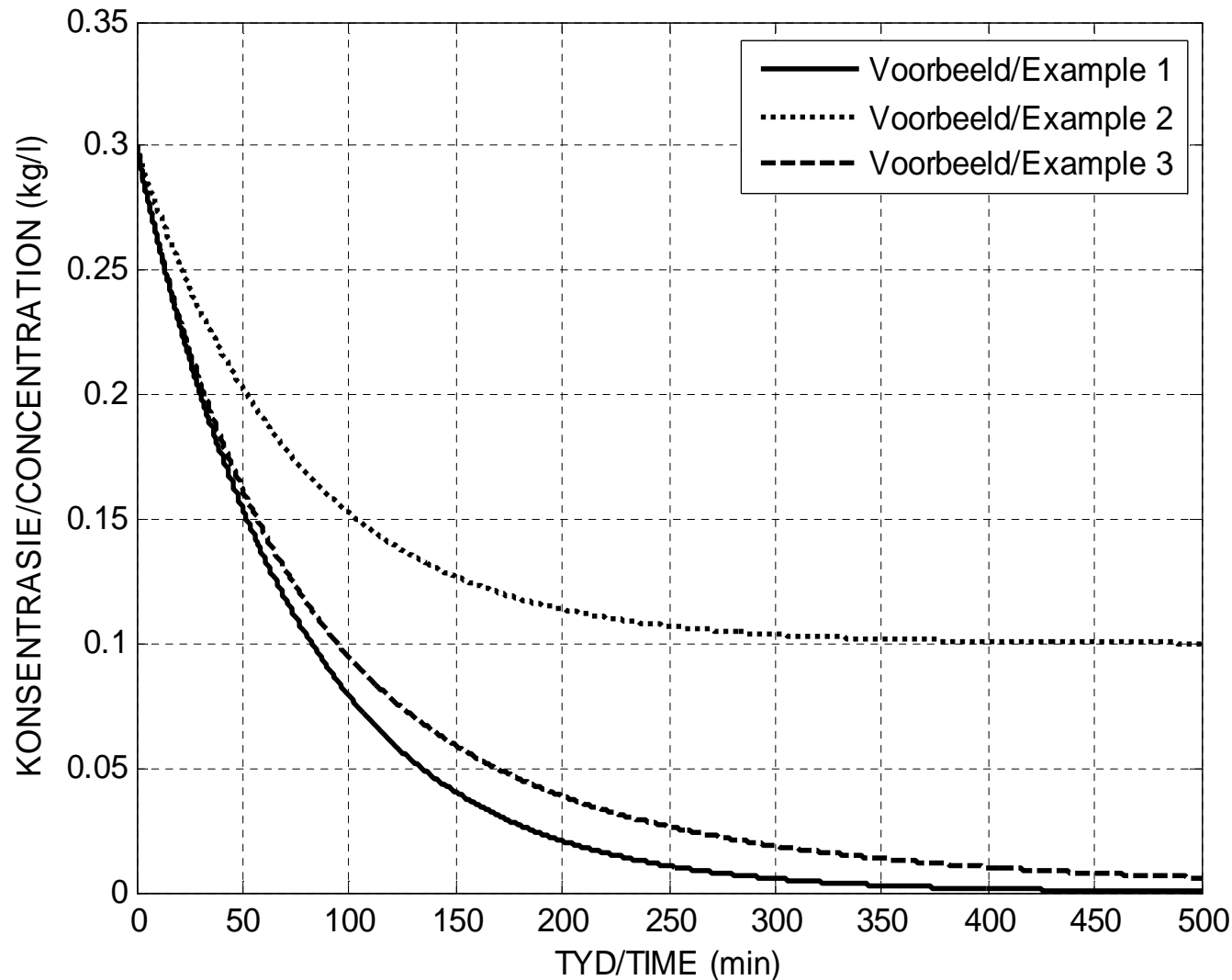
Antw / Ans: $c(t) = 0.1 + 0.2e^{-\frac{1}{75}t}$



VOORBEELD 3: 'n Tenk (met 1500 liter soutwater) bevat 'n konsentrasie van 0.3 kg sout per liter. Om die konsentrasie te verdun word suiwer water bygevoeg teen 20 liter/minuut. Die mengsel word goed geroer en verlaat die tenk teen 15 liter/minuut. Bepaal die konsentrasie sout in die tenk op enige tydstip t . **EXAMPLE 3:** A tank (with 1500ℓ salt water) contains a concentration of 0.3 kg salt per litre. In order to dilute the concentration, pure water is added at 20 ℓ/minute. The mixture is stirred well and exits the tank at 15 ℓ/minute. Determine the concentration salt in the tank at any time t .



Antw / Ans: $c(t) = \frac{(90)(300^3)}{(300 + t)^4}$



(SELFSTUDIE) Toepassing 6: Elektriese stroombane (p 22, 77, 78)
(*SELF STUDY*) Application 6: Electrical circuits (p 22, 77, 78)