



Basic rule of engineering

- It is easy to come upon a difficult solution

BUT

- It is difficult to come upon an easy solution
 - Staple
 - Paper clip
 - Zipper
 - Oxidation ditch

Nature is a great teacher

Contents

- The oxidation ditch:
 - a successful Dutch development
- Over half a century ago
 - Dr. ir. A. Pasveer, Middelburg, 1909 – Oudewater, 2001
- “Quest for simple waste water treatment”
- Ditch with an aerator without sludge retention, 400 “souls”
- Design rule: 0.05 kg BOD / kg sludge.day
 - or: 1000 g sludge per p.e.
- Quest for simple natural methods for water reuse

*The oxidation ditch
a personal history with a future
Ruud Kampf*

Voorschoten

Bild 1: Uniform des Oxidationsgraben. Voorschoten bei Dordrecht. Einfacher Durchlaufbetrieb. Bron: Kees van Loohuizen – Afvalwaterzuivering in Nederland

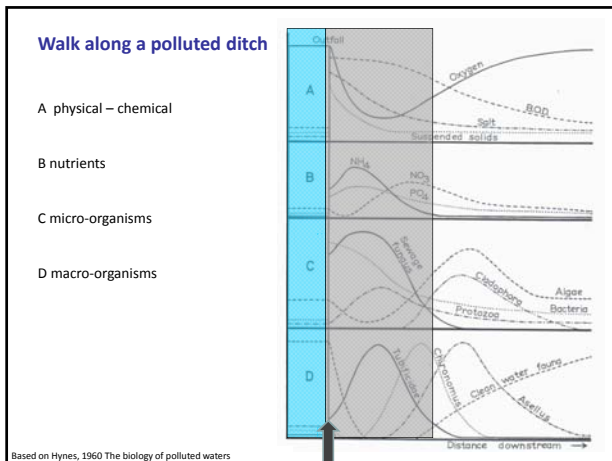
An oxidation ditch

A new oxidation ditch

An old oxidation ditch

TECHNICAL & SOCIAL TOUR Thursday

STP Empuriabrava



Work report on experiments in an aeration plant for sewerage water at the Dobbe-weg in Voorschoten during the era 14 July - 1 October 1954

- ...ditch was filled with a black and stinking water mass ... by household water of 400 "souls"...
- "the existing ditch was changed in a ring shaped circuit"
- Conclusions:
 - ... by aeration alone the waste water can be changed in such a way that it can be discharged without objections...
 - ... but a very simple sludge settler would be preferred

Simple waste water treatment - 1

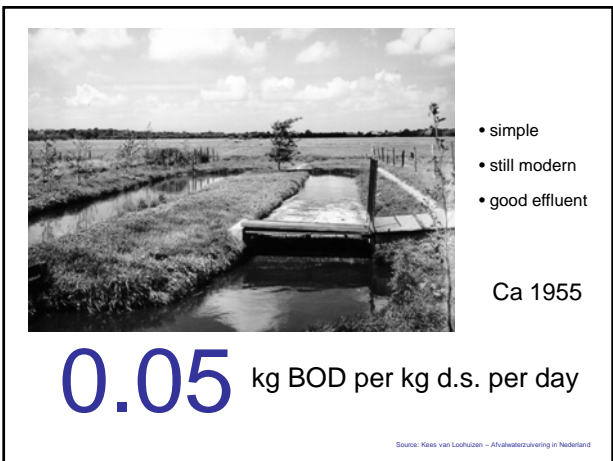
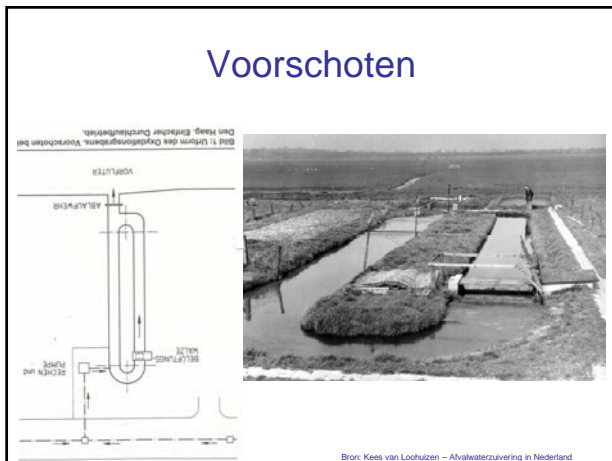
- "...It also can be seen as a river: the natural aeration of a large surface is replaced by an artificial aeration and the added waste water is mixed with already cleaned sewage instead of surface water..."
- "...at construction the already existing ditch could be used (=one leg of the circuit. It was sufficient to complete the circuit plus install an aeration brush and a discharge weir..."
- "...when sewage is added continuously ... continuously treated water is discharged over the weir, an effluent is obtained of which:
 - the oxygen need is reduced by 90 % and the effluent contains several hundred mg of sludge per liter..."
- "...the circuit contained amply oxygen..."

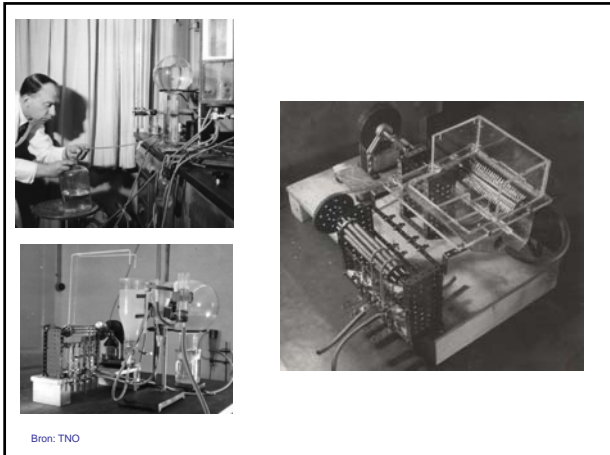
Simple waste water treatment - 2

- "...when the surface water has enough flow ...than the sludge can be discharged without any objections with the effluent.... It can even stimulate life in the receiving water ...
- "...but in our low and flat country ... this lead to a further development of the system....."

Simple waste water treatment, 1957


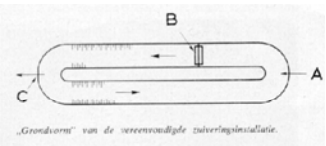
Uit: dr. Ir. A. Pasveer, Eenvoudige afvalwaterzuivering, DE INGENIEUR, G. Gezondheidstechniek 1., 69e jaargang No. 17, 26 april 1957. G.1



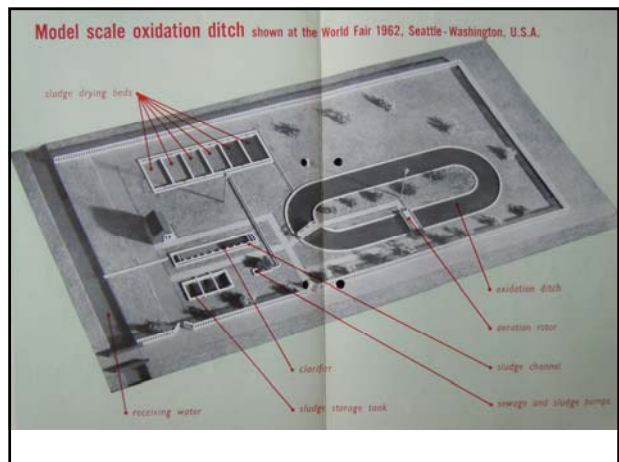


Oxidation ditch

Dutch development, A. Pasveer 1909 - 2001

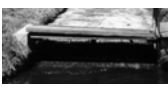



Original: “*simplified treatment plant*”
 A while later: “simple waste water treatment”
 Only around 1960 “Oxidation ditch”




Basic design oxidation ditch

- Sludge load 50 g BOD/kg sludge.day
- Influent 50 g BOD/pe per day →
 – **Workmaterial = 1 kg slib / pe**
- 4 kg sludge d.s. per m3
 – → 4 pe per m3 → 1 pe = 1000 / 4 = 250 l
 – 125 l/pe.day → retention time is 250 / 125 = 2 days
- Sludge growth 40 g pe / day
 – Sludge age is 1000/40 = 25 days
- Cage aerator 500 pe/m length
 – 1 pe = 0.2 cm aerator length




Carrousel®: how it started...




1964 Invented and developed by DHV
1968 First Carrousel® build

Brochure DHV, 1975, internet 2007

ODN – TNO-Delft

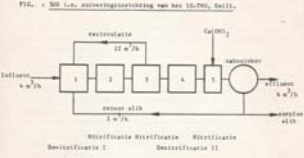


Oxydenitroprocess
Ruud Kampf involved from 1974 – 1991
Still an oxidation ditch



In Oxidation- and Denitrifikationsprozess
Der Prozess des in dieser Anlage bei 15-20°C ablaufend in 12, 17 Stunden.
Der Abfluss von der 300 L/s, Installationswert gegeben in Tab. 10.

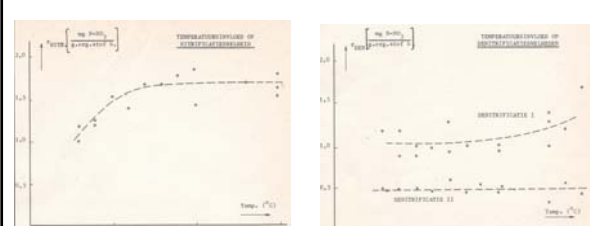
Fig. 10: L.L. untervergrößerung von bei 10-20°C, Delft.



Beispiel von der Wäschung von 200 m³/h (10, 17, 18, 19, 20, 21, 22, 23)

Parameter	1	2	3	4	5	6	7	8	9	10	11	12
DO (mg/l)	10.1	3.3										2.3
NO ₂ (mg/l)	48.4	8.5	3.8	1.8	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2
NO ₃ (mg/l)	7.3	1.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
N-tot (mg/l)	11.0	6.8	10.7	17.0	8.5	8.6	8.6	8.6	8.6	8.6	8.6	8.6
DO ₂ (mg/l)	8.20	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30

ODN – kinetics oxidation ditch



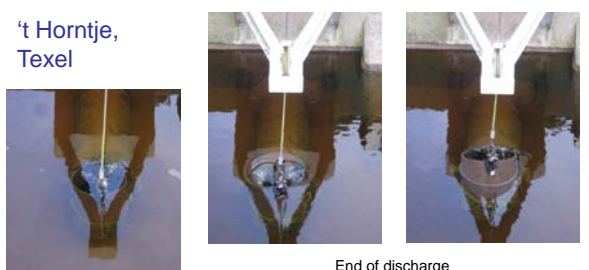
Typical rates (mg/N-NO₃/g. org.h)

- Nitrification: 1.5 – 2.0
- Denitrification based on C-source: 1.0 - 1.5
- Denitrification based endogenous respiration: 0.5

Figuur 10: Influence of temperature on nitrification- en denitrification kinetics (Heide, 1975)



't Horntje, Texel



End of discharge

Results 1991 – 1993 (mg/l)

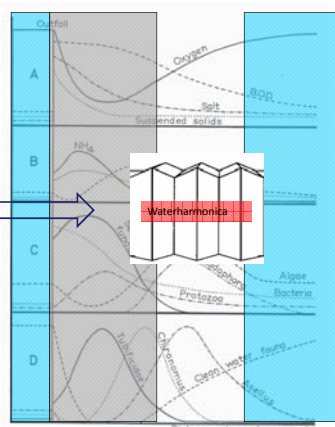
BOD	2.8	NH ₄	1.0
COD	42	NO ₃	1.8
		N-tot	4.9

Begin discharge

Dismantled in 2007

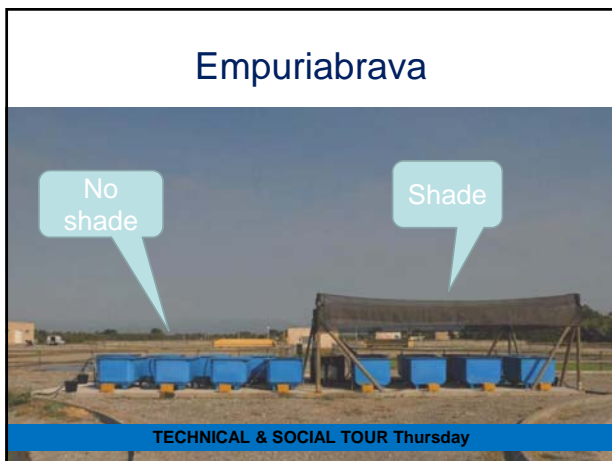
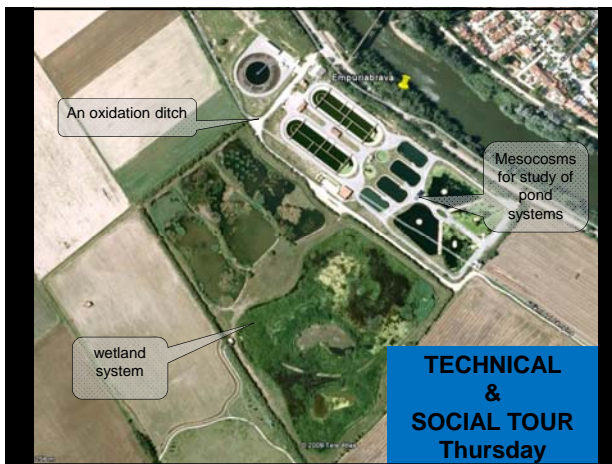
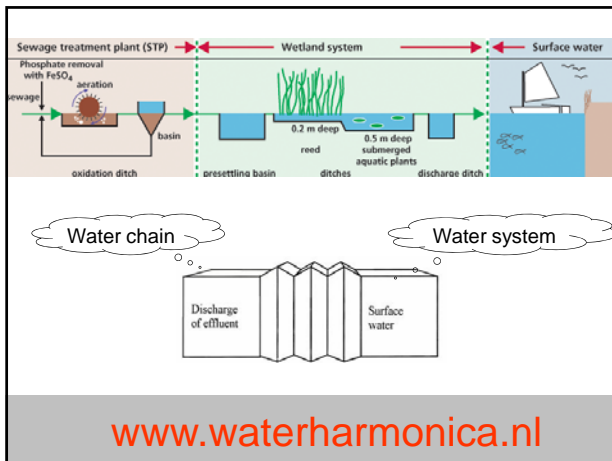
Walk further along a ditch

Bridge between sewage treatment and surface water



Waterharmonica

Based on Hynes, 1960 The biology of polluted waters



- ### Conclusions
- Simple waste water treatment:
 - “Improving a polluted ditch”
 - Oxidation ditch
 - Simple but great effluent quality
 - Robust
 - Fully nutrient removal
 - *Very usable in developing world*

Conclusions: the future?

- Effluent to good to throw away:
 - Upgrade with natural processes
 - It is not waste water treatment anymore but:
 - closing the water cycle
 - producing a usable water
 - Or: giving water back to nature

The oxidation ditch
is personal history with a future
Simple natural processes for upgrading treated waste water

Waterharmonica

Linking well treated waste water with nature

water²net

Discussion-1

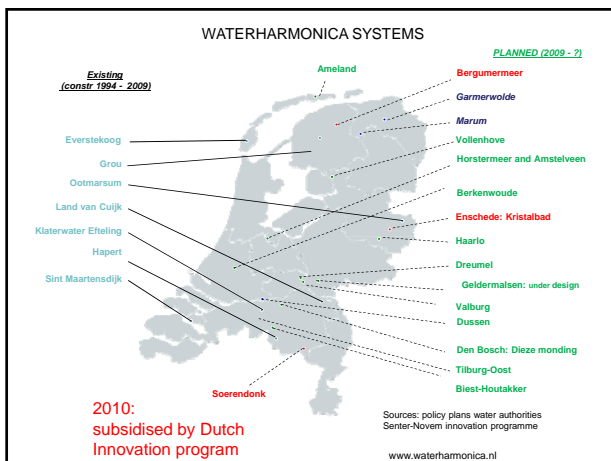
Natural processes to convert treated waste water into a usable surface water

a Dutch-Catalan cooperation

Ruud Kampf and Lluís Sala

AIGUA A LA CARTA
Processos i tecnologies:
L'adequació de la qualitat de les aigües als diferents usos
19 de Novembre 2009
Gran Hotel Princesa Sofia, Barcelona

water²net vrije Universiteit amsterdam CONSORCI DE LA COSTA BRAVA



Waterharmonica Soerendonk

New Waterharmonica system

- part of landscape reconstruction plan
- converting treated waste water into a quality suited for nature
- creating wet nature
- water storage, flood prevention

Project cost € 1.859.829
Innovation subsidy € 929.915
Ready in 2010

Zie: Primeur op rwzi Soerendonk, H₂O/16-17-2009

