

Workshop on Sustainable Sludge Handling

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Media Docks Lübeck MF 500, Willy-Brandt-Allee 31a, 23554 Lübeck

# Characterisation of sludges trends and developments affecting sludge strategies

*Dr. Tim Evans,*

*Convenor, European Committee for Standardization,  
Technical Committee 308 WG3*

*TIM EVANS ENVIRONMENT, Stonecroft, Park Lane, Ashted, KT21 1EU, England*

# Trends & developments

- Disproportionate fear of hazards
  - Inorganics
  - Organics
  - Pathogens
  - Quantification
- Resource recovery
  - Energy
  - Phosphate
  - Ammonia
- Odour
- Climate change

# Disproportionate fear of hazards e.g.

- Emission from incineration / combustion
  - Exhaust might be cleaner than ambient air
  - Why should the standards for the air be different for power-stations and incinerators?
- Emission from biogas engines
  - Disproportionate compared with vehicle engines
- Sludge recycling to land
  - Disproportionate compared with manures ...
- Lack of proper risk assessments
- Limits not linked to analytical capability

- CEN/TR 13714 Characterization of sludges - Good practice for sludges **management in relation to use or disposal**
- CEN/TR 13097 Characterization of sludges - Good practice for sludges **utilisation in agriculture**
- CEN/TR 13983 Characterization of sludges - Good practice for sludge utilisation and **land reclamation**
- CEN/TR 13767 Characterization of sludges - Good practice for sludge **incineration with or without grease and screenings**
- CEN/TR 13768 Characterization of sludges - Good practice for combined **incineration of sludges and household waste**
- CEN/TR 15126 Characterization of sludges - Good practice for the **landfill** of sludge and sludge treatment residues
- CEN/TR 15473 Characterization of sludges - Good practice for **sludge drying**
- CEN/TR 15809 Characterisation of sludges – **Hygienic aspects – Treatments**
- CEN/TR 13846 Characterization of sludges - **Guide to preserve and extend sludge utilisation and disposal routes**
- CEN/TR 15584 Characterization of sludges - **Guide to Risk Assessment especially in relation to use and disposal of sludges**
- CEN/TR 15175 Characterization of sludges — **Protocol for conducting inter-laboratory trials** of methods for chemical and microbiological analysis of sludges

# Hazard – Risk

- We know a lot about risks if we chose to apply the evidence
  - **Harm** - physical injury or damage to the health of people or damage to property or the environment
  - **Hazard** - potential source of harm
  - **Risk** - combination of the probability of harm occurring and the severity of that harm

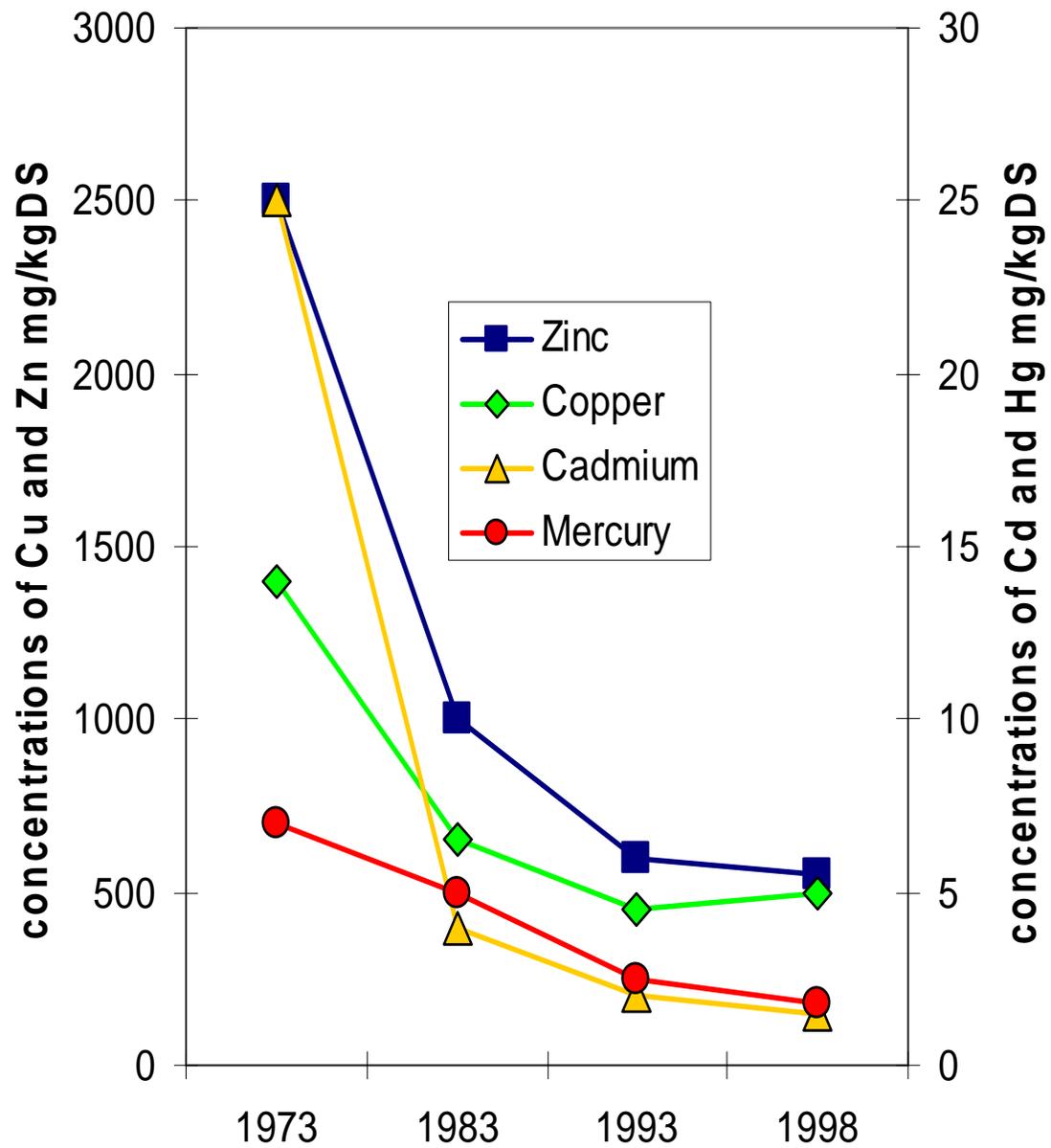


- Paracelsus (1493-1541):  
"*Dosis facit venenum.*" ("The dose makes the poison.")

Source ► Pathway [delivering dose] ► Receptor

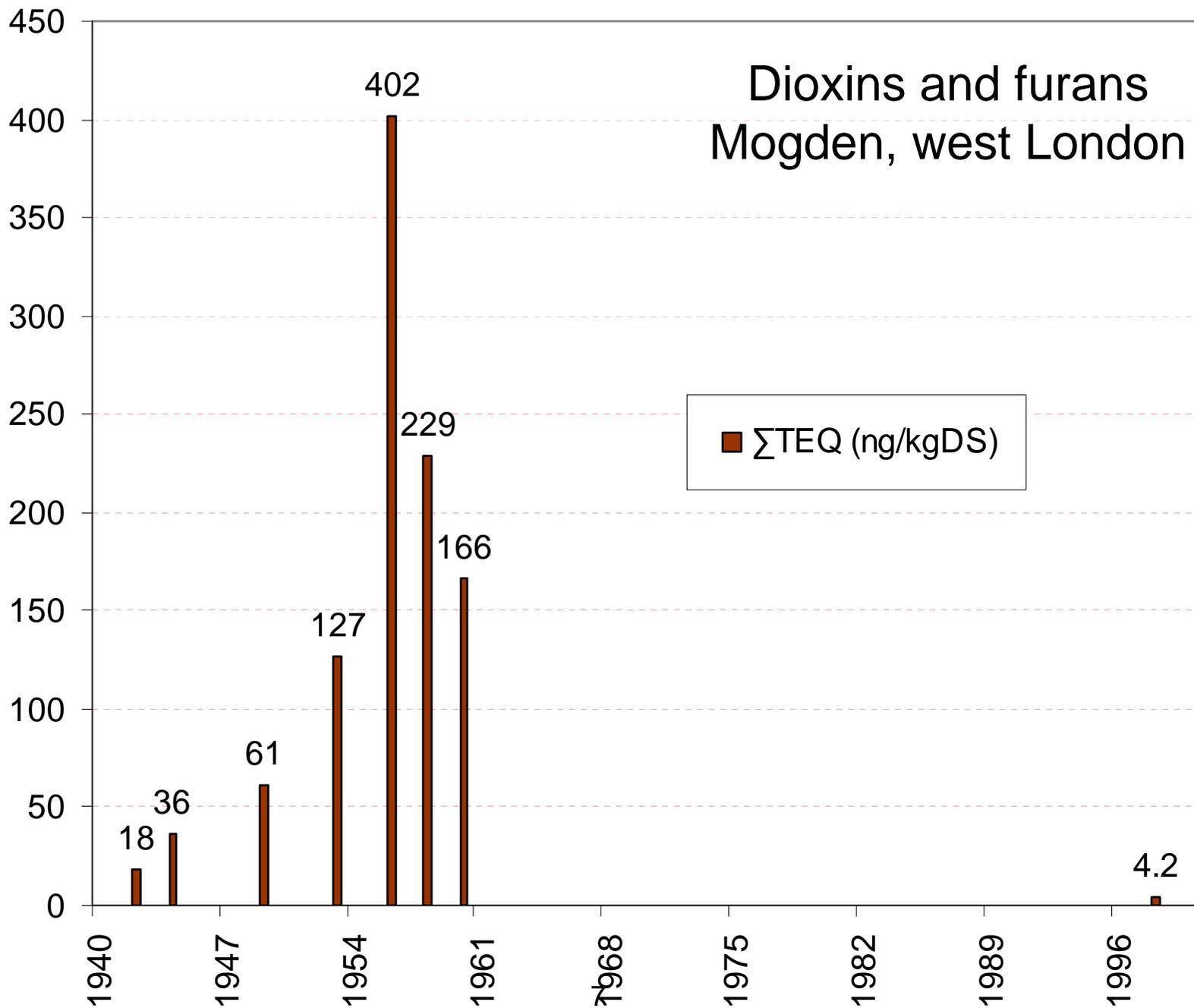
If any one of these is missing, there is no risk.

- Most chemicals used in society can be found in sludge, presence is not the issue, the issue is risk
- I don't know any risk assessments of sludge to land more rigorous than those by the USEPA

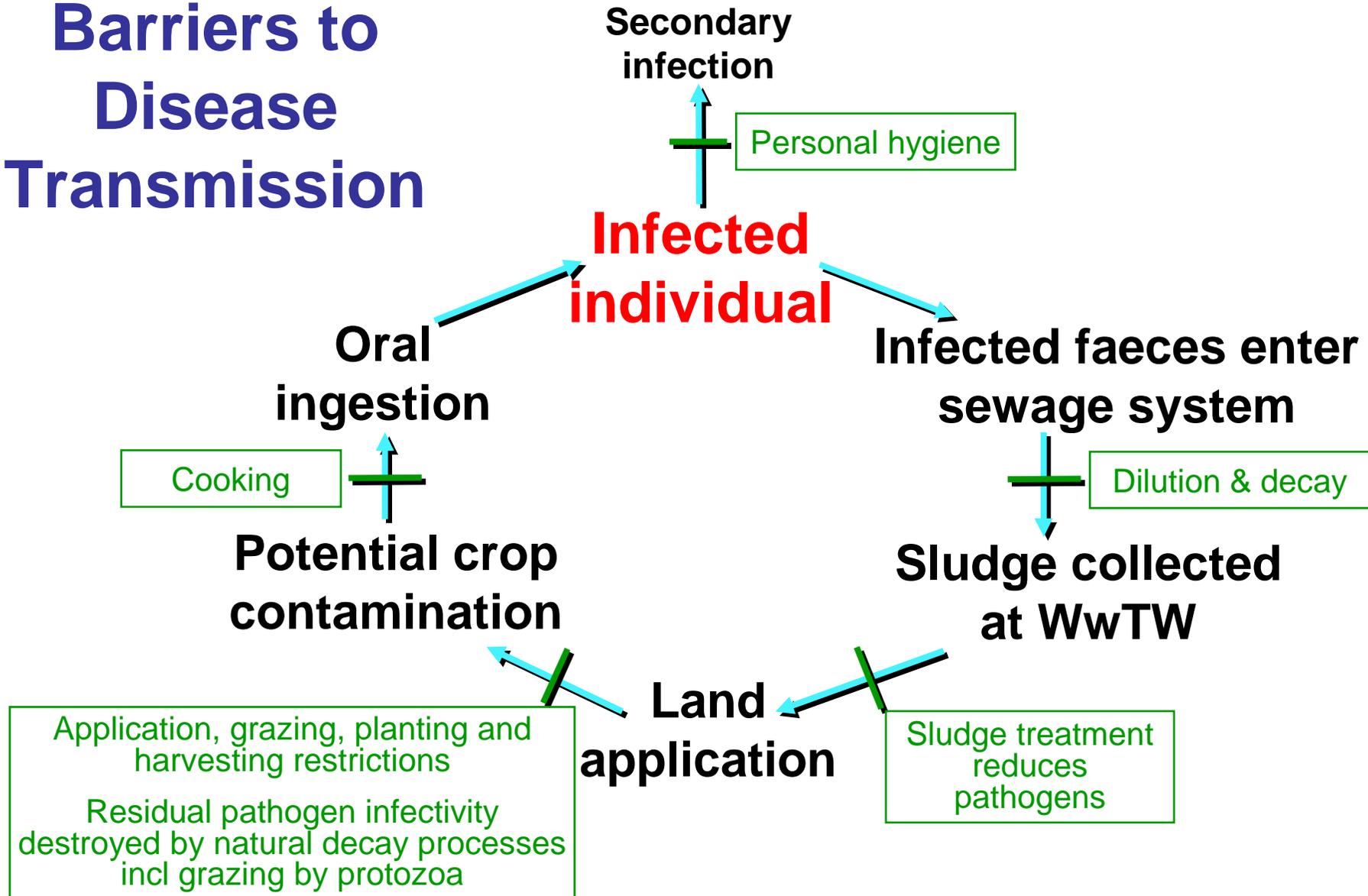


metals in sludge from Stockholm's Henriksdal and Bromma

# Dioxins and furans Mogden, west London

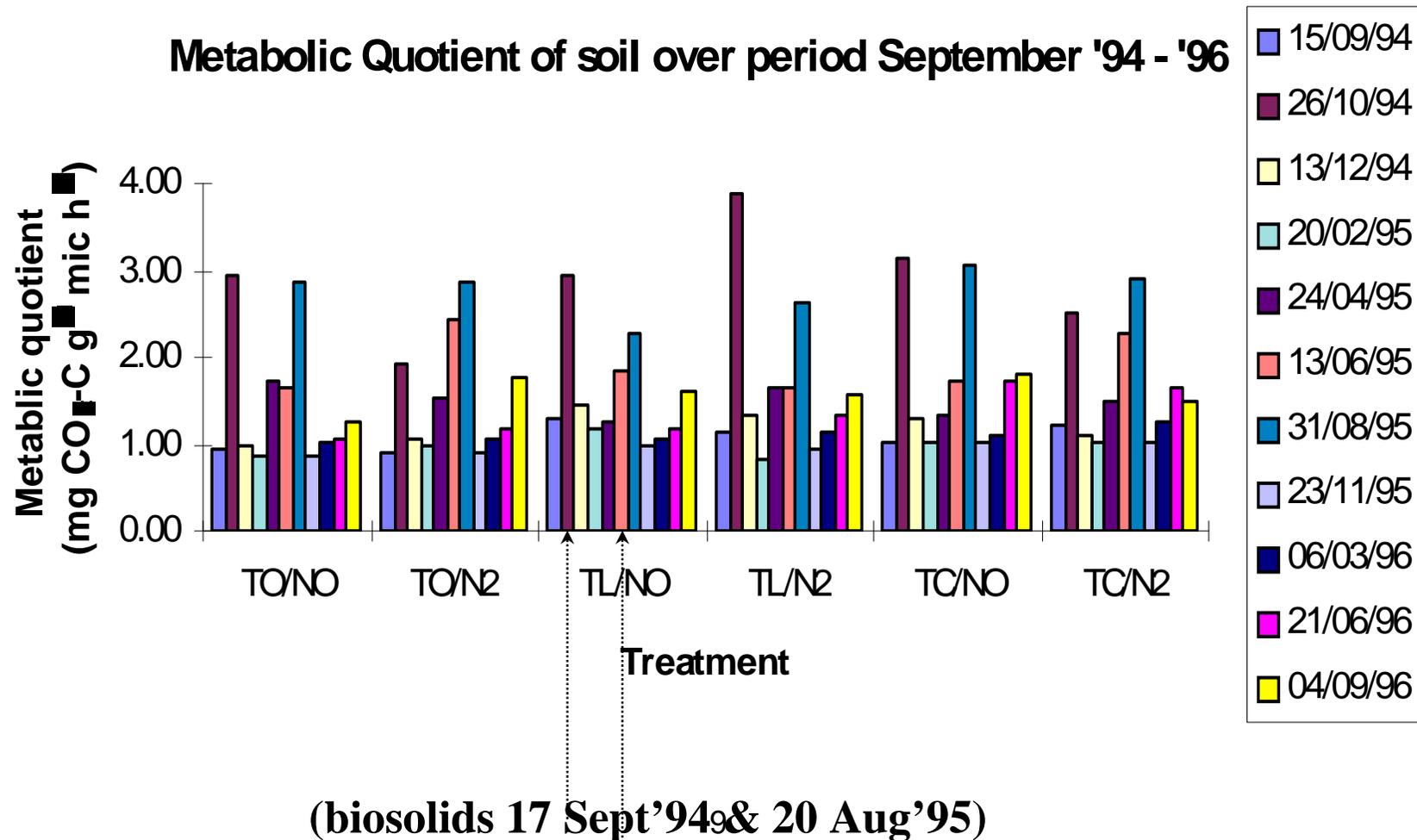


# Barriers to Disease Transmission



**Note: Sudden increase – Viable but non-culturable**

# Replicated operational scale field trial – bioassay for ‘unknown’ pollutants (+ stress event IPU 24 Oct'94)



# Perception

- how risks and our activities are perceived is no less important than “actuarial” risk

perceived risk = risk + outrage      [www.psandman.com](http://www.psandman.com)

- Outrage factors

- involuntary (out of my control)
- artificial and industrial,
- unfamiliar and/or exotic,
- hard to understand (not self-explanatory, imbued with complexities),
- memorable (because of odour, noise or other nuisances),
- dreaded (disease, pollution, endocrine activity, cancer),
- not reversible (e.g. persistent pollutants added to soils),
- affecting future generations (uncertainty about long-term impacts),
- unfair
  - the farmer gets the benefits and the neighbour only gets nuisance/risk
  - city dwellers dumping on rural dwellers

- If you reduce “outrage” you bring perceived risk closer to actuarial risk

# Reducing outrage

- Avoid odour nuisance
- Smart, clean operation
  - no mud on roads
- Consideration for neighbours
  - avoid school congestion, weddings, funerals, ...
  - leaflet drop to inform – “we shall start Thursday and finish Friday”
- Celebrate/explain the benefits of biosolids
  - talk with the media
- Branding differentiates



# Quantification

- How reliable are the results?
  - If 2 laboratories analyse the same sample do they get the same results?
  - compliant / not compliant
- Are the limits in legislation realistic compared with labs' capabilities?
  - “less” is not necessarily better / safer
- Sampling [representativeness] and sample preparation are as [more] important as final analysis

# Resource recovery - energy

- Anaerobic digestion – biogas
  - WAS pretreatment
  - Co-digestion
    - Financial viability is related to quantity and quality of feed
    - Food waste disposer
  - Biomethane
  - Dewatering
- Incineration after advanced AD give more energy than raw incineration
  - Avoid squandering P
- Gasification and oil-from-sludge all unlikely



# Resource recovery - phosphate

*“...life can multiply until all the phosphorus is gone, and then there is an inexorable halt which nothing can prevent.... We may be able to substitute nuclear power for coal, and plastics for wood, and yeast for meat, and friendliness for isolation - but for phosphorus there is neither substitute nor replacement.”*

Isaac Asimov, “Asimov on chemistry” (June 1974)

ISBN 0385041004, Doubleday Company, New York

- Phosphate is essential for all living cells, but scarce.
- Wastewater, biosolids and organic resources have a major part to play in the stewardship of this essential resource.
- The phosphate crisis is on a par with climate change as a threat to the human population

## World phosphate rock production and reserves (Mt) (after Heffer et al., 2006)

Country	Production in 2005	Reserves	Reserve base	% of total
Morocco & Western Sahara	28.8	5700	21000	56.7%
USA	35.5	1000	4200	11.0%
South Africa	2.6	1500	2500	8.5%
Jordan	6.4	900	1700	5.5%
China	51.0	500	1200	3.6%
Russia	11.3	150	1000	2.4%
Tunisia	8.2	100	600	1.5%
Brazil	5.5	330	370	1.5%
Israel	2.9	180	180	0.8%
Senegal	1.5	50	160	0.4%
Syria	3.5	60	100	0.3%
Togo	1.0	30	60	0.2%
Other countries	13.1	1000	2500	7.4%
<b>Total</b>	<b>171.3</b>	<b>11500</b>	<b>35570</b>	
Years at 2005 production		67	208	

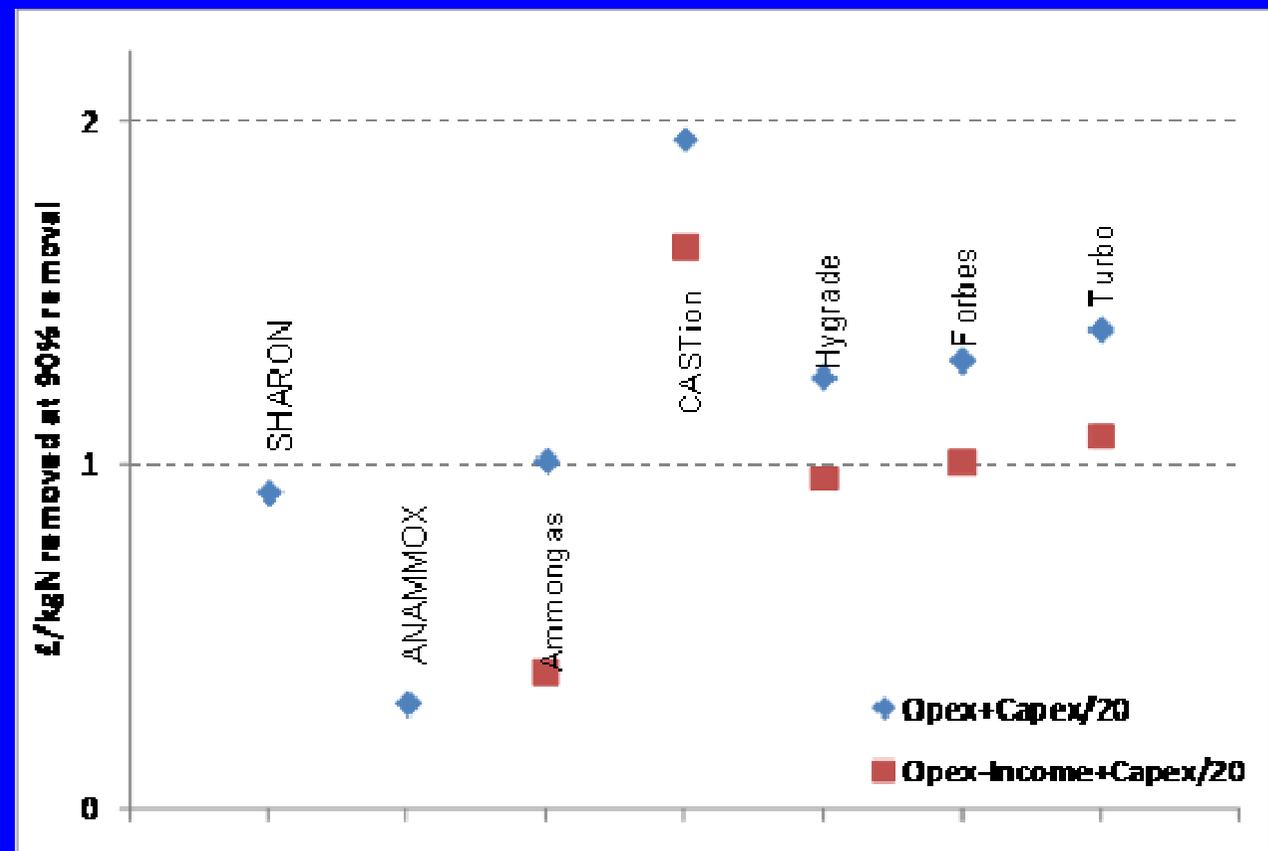
Morocco  $\approx$  80 mg Cd /kg P<sub>2</sub>O<sub>5</sub> sewage sludge  $\approx$  30 mg Cd /kg P<sub>2</sub>O<sub>5</sub>

# Resource recovery - phosphate

- Sweden has a P recycling target, Germany will have one in 2012. Probably, eventually the EU will have one.
- More people wanting more food [and more meat]; less farmable land; P running out. Climate change has had all the attention but P crisis is no less serious – just less visible.
- Recovering P from dewatering liquor is becoming accepted as preferable to returning it to the head of the works, where it can be 25% of the P-load on the WWTW [struvite: PhosPac, Ostara, MultiHarvest, DIY].
- Alternatively recovering struvite from sludge before dewatering [AirPrex].

# Resource recovery - ammonia

- Ammonia in dewatering liquor can be 25% or more of the load if it is returned through a WwTW
- Unlike P, N is not scarce – air is 80% N<sub>2</sub> – for WwTW it is financial and carbon

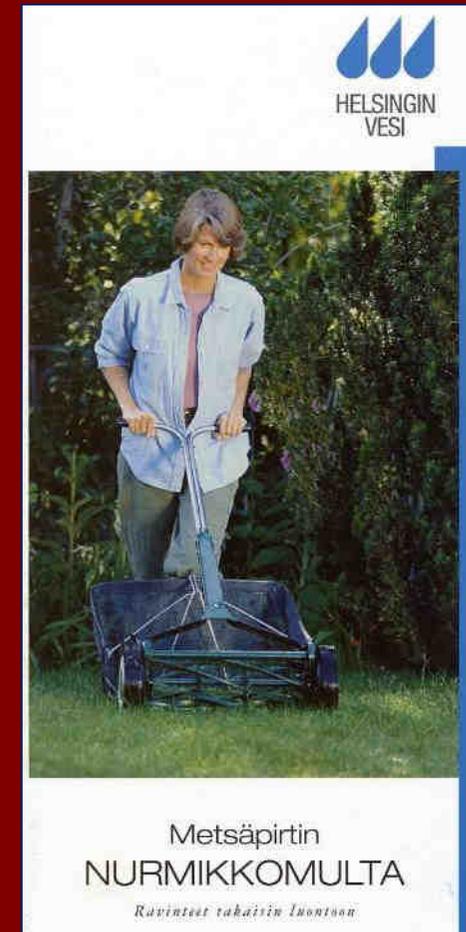


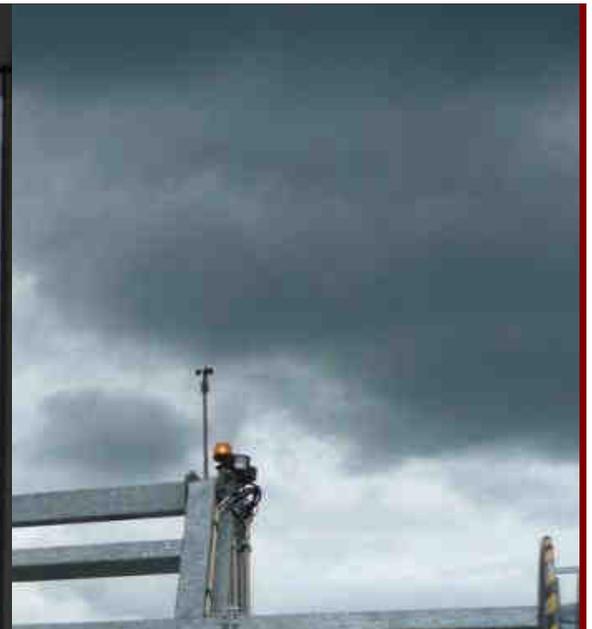
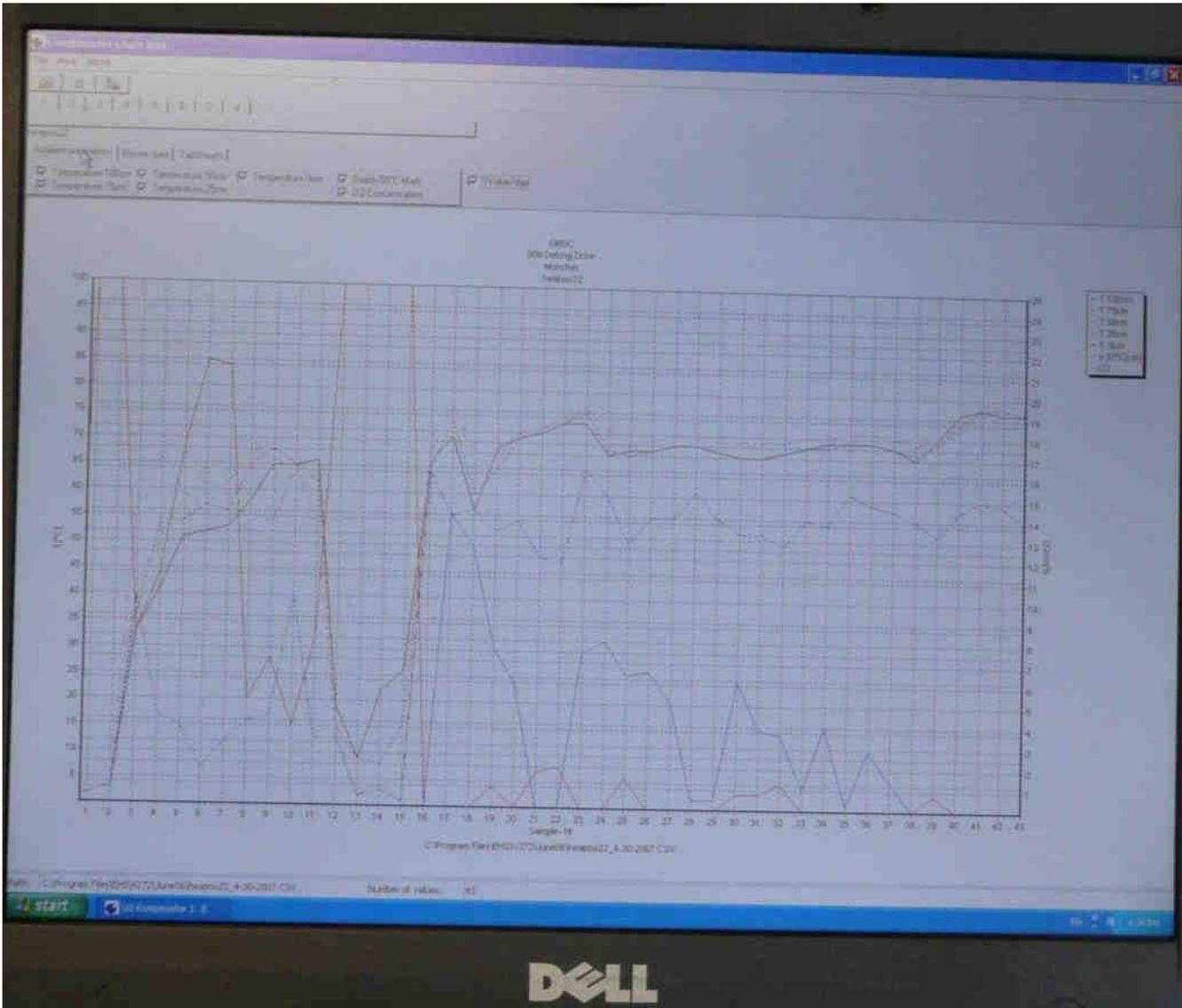
# Resource recovery - other

- Organic matter to feed soil
- K, Mg, S
- Minor nutrients
- Root bio-stimulants

# Resource recovery - composting

- If you want compost!
  - Do you have a particular market requirement?
  - Does your legislation drive you towards compost?





DELL

# Odour

- Odour is the root of >95% of complaints about sludge
  - Richard Axel and Linda B. Buck explained odour 2004 Nobel prize for Physiology or Medicine – 4% of our genes are coded for odour
- Severe outrage factor
- Causes people to look for other factors to amplify their objections

# Climate change reduction obligation

- Biogas mitigates climate change
  - Electricity
  - Renewable heat
  - Biomethane
- Recovery of ammonia and phosphate has smaller GWP than BNR
- $\text{N}_2\text{O}$  298 BNR and soil
- Dewatering

# Conclusions

- The science of the hazards and their risks has been researched but often restrictions are disproportionate
- CEN/TC 308 shares knowledge and has produced a body of documents to help sludge
- The circumstances (P, climate change, energy, cost) in which sludge management operates are changing – strategies need to reflect this