

Water and Wastewater Management in Food Industry – Presentation of 3 Case Studies in China and Mexico

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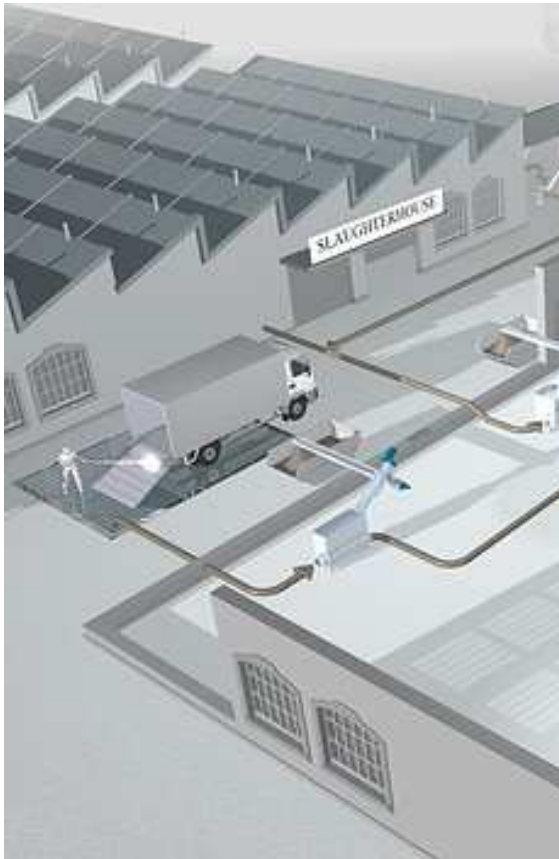
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Case study 1: Small Chinese slaughterhouse



Slaughterhouse:

Wastewater contains solids, grease/fat, organics (COD, BOD₅) and germs

Livestock and wagon washing:

wash water contains straw and sawdust

Quality of the wastewater

parameter	unit	concentration
COD	mg/l	1,000 - 6,000 (max. 20,000)
BOD ₅	mg/l	1,000 - 4,000 (max. 10,000)
N _{total}	mg/l	250 – 700 (max. 950)
Ammonium	mg/l	200 - 300
P _{total}	mg/l	80 - 120
settable solids	mg/l	10 (after skimming tank)
temperature	°C	20 - 35



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Current wastewater management at the slaughter house

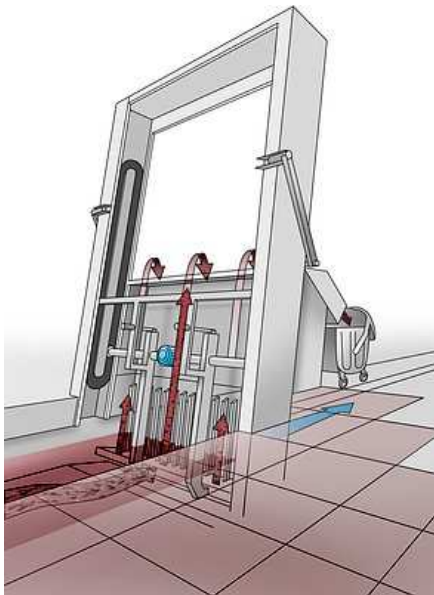
- Blood and other residues from slaughtering are collected manually
- The crude wastewater is currently treated by the following facilities:
 - Mechanical pre-treatment with fat separator and screen
 - Aerobic treatment with air injection
 - Final clarification (sedimentation and re-transfer of sludge)



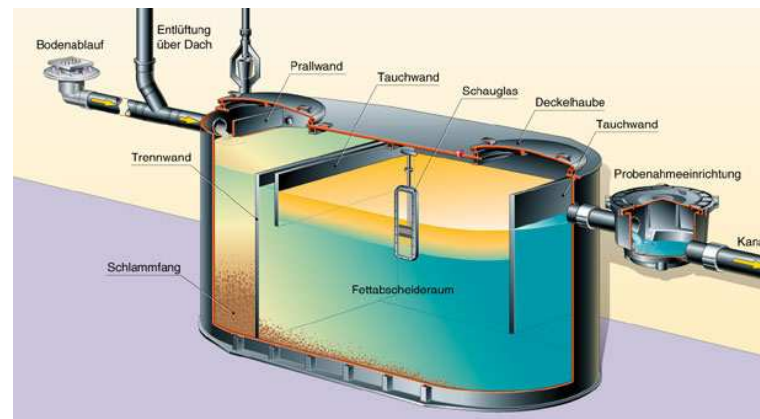
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Waste water treatment strategy (three stages)

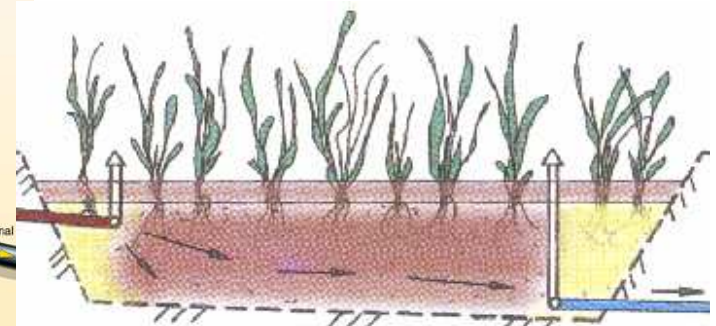
1. Screen
solids



2. Separator
**Elimination of
grease, fat**



3. Constructed Wetland
COD, BOD₅ and germs

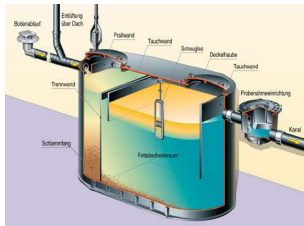


Scopes of improved wastewater management

- Reduction of fresh water use by optimisation of water consuming processes
- Decrease of wastewater amount
- Decrease of wastewater pollution by holding back efficiently slaughtering residues before reaching wastewater collection
- Passive after-treatment of wastewater
- Improvement of wastewater quality
- Enabling of re-utilisation of treated water
- Minimisation of environmental impacts



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Case study 1: Slaughterhouse in China



Case study 2: Meat industry in Mexico



Case study 3: Dairy industry in Mexico

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Key figures of current water and wastewater management

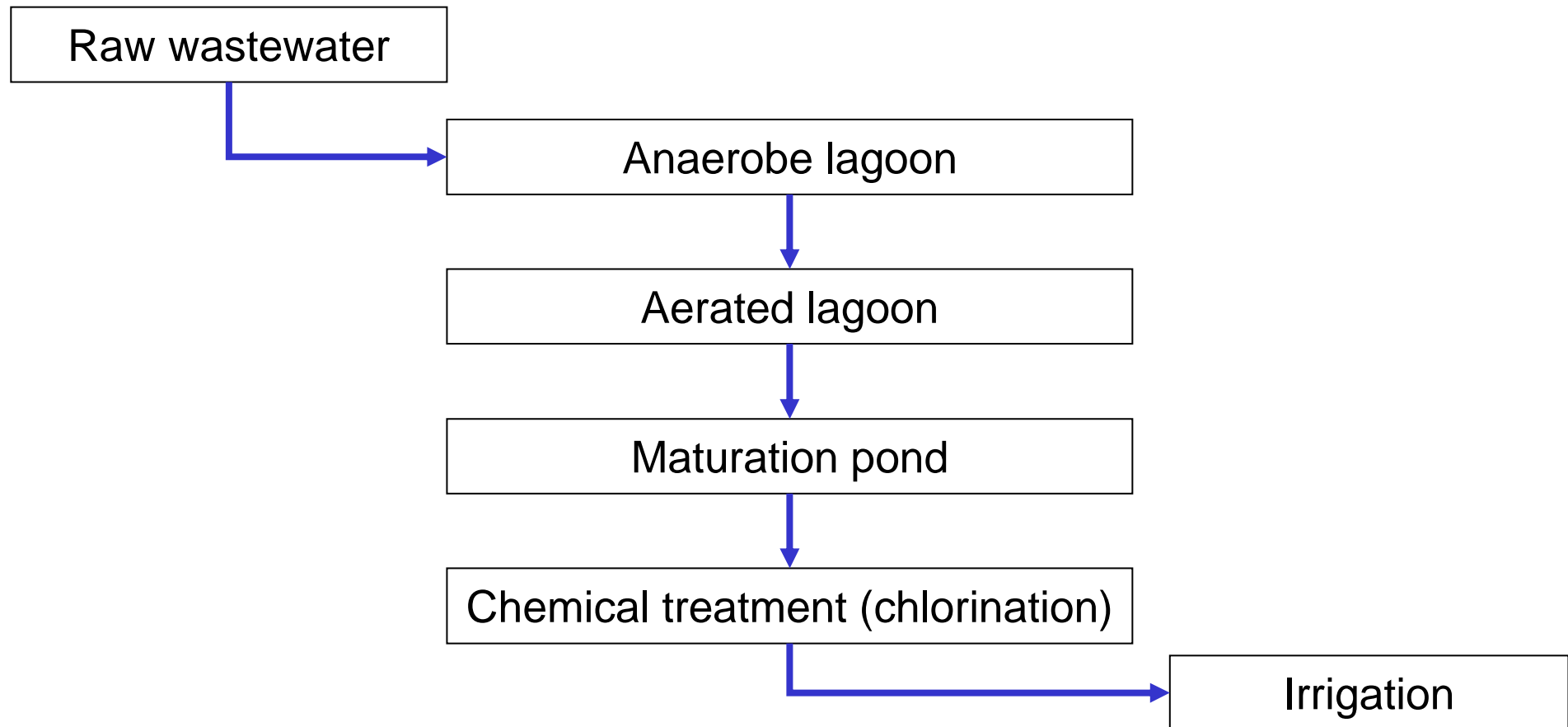
- Processing of approx. 400 tons of meat per day
- Fresh water demand: Ø 3,000 m³/day
- Wastewater amount: 2,500 - 3,000 m³/day
- Major substances in the wastewater:
 - Blood and solid slaughter residues, excrements, urine
 - Oil, grease and protein-compounds
 - Dirt
 - Disinfecting agents, tensides



Wastewater composition and comparison with international benchmarks

parameter	unit	range of concentration (literature)	range of concentration at site of case study (2009)
COD	mg/ l	1,000 – 6,000	2,020 – 16,020 (Ø 7,424)
BOD ₅	mg/ l	1,000 – 4,000	1,010 – 8,010 (Ø 3,717)
Ammonium (NH ₄)	mg/ l	200 - 300	Ø 143
P _{total}	mg/ l	80 - 120	Ø 58
settable solids	mg/ l	10 (after skimming tank)	Ø 2,882
temperature	°C	20 - 35	Ø 27

Wastewater treatment facilities



Options for reduction of fresh water consumption

- Use of dry cleaning techniques previous to the wet cleaning
- Conversion of water-using cooling systems from once-through cooling systems to closed circuit coolers
- Use of heat recovery systems and decrease of cooling water consumption
- Substitution of potable water where lower quality requirements are acceptable, e.g. for heating and steam production, fire fighting, outside cleaning
- Utilization of steam condensates from energy production and of the warmed cooling water from heat exchangers as cleaning and process water
- Use of fittings for reduced flow rates



Options to reduce wastewater pollution

- Enhanced separation of blood (main pollutant)
- Reduction of immission of solid slaughterhouse wastes into the wastewater
- Sufficient dimensions of the drainage channels and gratings (mesh size)
- Regular cleaning of the gratings of drainage channels
- Preliminary dry cleaning of equipment and rooms before wet cleaning
- Split-up of the wastewater collection system into a branch for polluted wastewater and another branch for unpolluted rainwater and cooling water
- Use of biodegradable disinfectants and minimizing their consumption
- Substitution of halogen containing or halogen emitting disinfection agents by oxygen emitting agents
- Integration of a biological wastewater treatment plant

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Options for biological after treatment of wastewater

	Efficiency of BOD ₅ reduction	Required surface to treat 3,000 m ³ /day
Wastewater pond without aeration	50-70%	375,000 m ²
Wastewater pond with aeration	65-90%	50,000 m ²
Constructed Wetland	80-85%	25,000 m ²

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Key figures of current water and wastewater management

- Processed raw milk: 600 m³/day
- Fresh water demand: 1,600 m³/day
- Wastewater: approx. 1,300 m³/day
- No wastewater treatment besides of a fat separator
- Discharge of wastewater to local sewage plant
- Major substances in the wastewater:
 - Whey (e.g. from drip losses), pieces of cheese
 - Grease and oil
 - Acidic and caustic cleaning/disinfecting agents
 - Spilled away product charges that do not comply with quality standards



Wastewater composition and comparison with international benchmarks for the dairy branch

parameter	unit	range of concentration (literature)	range of concentration at site of case study
COD	mg/ l	650 - 4400	9,475
BOD ₅	mg/ l	500 -2000	3,750
Oil + Grease	mg/ l	20 - 250	1,384
N _{total}	mg/ l	30 - 50	240
P _{total}	mg/ l	10 - 100	227
settable solids	mg/ l	1-2	1.2
Coliforme bacteria	Cfu/ 100 ml	unknown	1.2*10 ⁶

Causes of high wastewater pollution

- High loads of milk, whey and cheese residues are getting into wastewater by:
 - Trickling losses of milk and whey
 - Abrasion of cheese pieces during handling and transport
 - Mixing of cleaning water with product rests in tanks, pipes, production and transportation facilities, floors
- Product charges that do not comply with quality standards are spilled away into wastewater system
- Non-sufficient fat separator
- High application of nitrate and phosphorous containing cleaning and disinfecting agents

Options for reduction of fresh water consumption

- Complete emptying of containers and pipes before cleaning (if possible utilization of compressed air to remove residues before rinsing with water)
- Re-use of final clear rinsing water from cleaning of pipes and tanks as pre-cleaning water can reduce fresh water demand for cleaning by 20%
- Avoidance of leakages:
 - Regular controls of pipes and tanks
 - Welded instead of screwed pipe connections
- Use of coolers with closed water circuit



Options to reduce wastewater pollution

- Separated collection and re-utilization of rejected product charges instead of spilling away into wastewater system
- Dry cleaning prior to wet cleaning and separated collection of solid residues
- Efficient collection and re-utilization (e.g. animal feed) of trickling losses and other production residues
- Prevention of creaming and sticking of milk onto surfaces by quick emptying and cleaning of containers and production lines



Required efficiency of pre-treatment

- Besides measures to prevent product losses during production a suitable treatment of wastewater is necessary
- Current fat separator has to be improved or replaced (German limit value of oil and grease for indirect discharge: 200 mg/l, actually: 1,384 mg/l)
- Requested standard for incoming wastewater at local sewage plant is 5,000 mg/l COD
- Actual COD in discharged wastewater is >9,000 mg/l (max. 21,000 mg/l)
- Therefore a pre-treatment plant is required to cut COD by 50% or more
- For such high organic loads a combination of anaerobe and aerobe treatment is favorable



Muchas gracias por su atención!

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