

p2m berlin GmbH

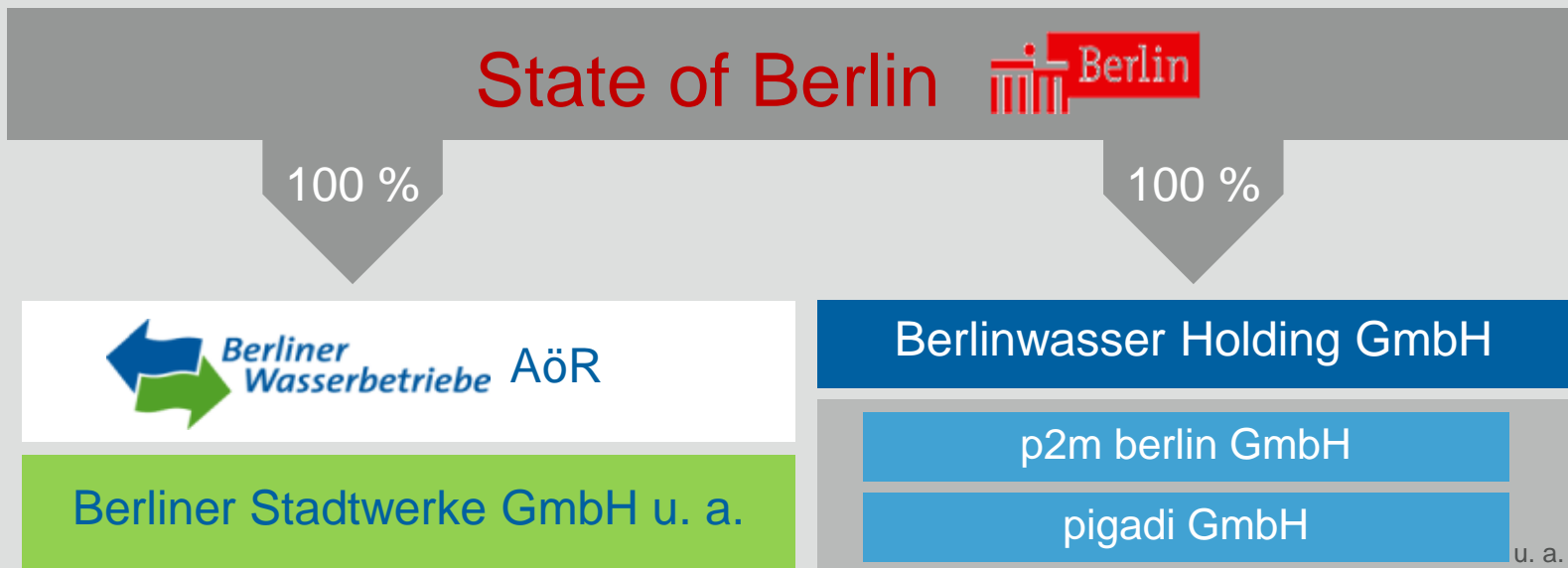
**Tubli Water Pollution Control Centre –
Expansion of Sewage Treatment Plant with
First Sludge to Energy Concept in the Middle East**



Berliner Wasserbetriebe

Water Supply and Waste Water Disposal
for the Capital of Germany

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p2m berlin GmbH

Engineering Company of Berlinwasser

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Data and Facts about p2m:

- Founded in: 1992
- Representative Offices in:
 - Berlin (Headquarter)
 - Albania
 - Azerbaijan
 - Kingdom of Bahrain
- Subsidiary Company:
pbv potsdam GmbH



Fields of Competence

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Administration Accounting Controlling	p2m berlin GmbH							Quality Management Safety Regulations
BWB	Drinking Water Supply	Stormwater Management	Waste Water Collection	Waste Water Treatment	Sludge Management	Project Management	Consulting and Supervision	BWB
Regional								Regional
National								National
International								International
Building Construction Structural Design Process Design Plant Construction E/PLT								

Sludge Management - Introduction



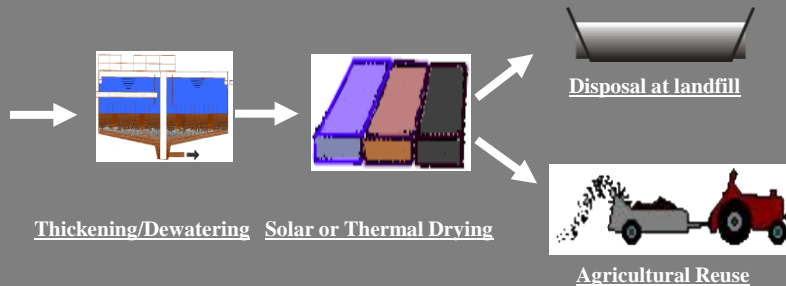
Source: Veolia.com

Main Keys to Sustainable Sludge Management:

- **Sustainable Sludge Reuse/Disposal Routes**
 - Land availability
 - Existing industries
 - Existing agriculture/landscaping
- **Sludge to Energy Concepts (Energy Recovery)**
 - Biogas
 - Mono-Incineration (sludge only)
 - Co-Incineration (cement industry, solid waste)
- Sludge Treatment Options depend those 2 key factors

Sludge Disposal in GCC & Middle East

Common Sludge Management Strategies in the Middle East



- Mostly sludge drying and disposal in landfills

⇒ **NOT A SUSTAINABLE SOLUTION**

- Limited reuse in agriculture and landscaping
 - sludge quality concerns (Pathogens, Heavy Metals),
 - limited/insufficient land availability

⇒ **LIMITED SUSTAINABILITY**

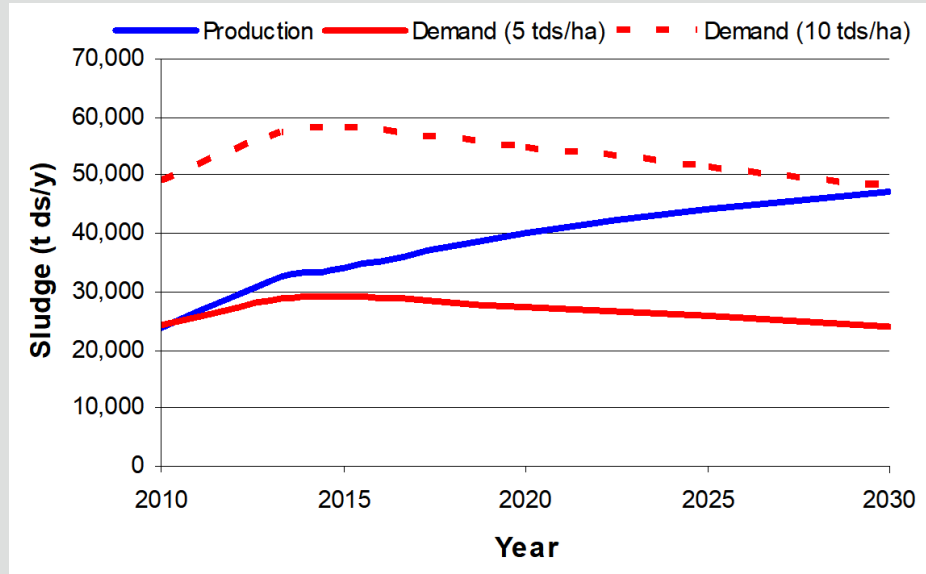
limited by climate & geology, farmland availability, cultural concerns and acceptance

Sludge Disposal in Bahrain

- Sludge is Dried to 90% and pelletised
- Agricultural Reuse not accepted by farmers due to limited sludge quality – odour and vermin problems
- Bahrain is a small island with limited land availability
- Sludge Production by far exceeds Demand
- All sludge is trucked to landfill

➔ NOT A SUSTAINABLE SOLUTION

- In 2010 decision to incinerate sewage sludge to reduce quantities and increase reuse options



Energy Content in Sewage Sludge – Germany



Energy Equivalent

10 kg org. DS ~ 6 ltr. diesel

Generated Sewage Sludge in Germany:

- Total Dry Solids (2014): app. 1,900,000 t/a
- Organic Content: app. 50 - 55 %
- Total Organic Matter (2014): app. 1,000,000 t/a
- Specific Heat Value: app. 23,000 kJ/kg

Total Energy Content in the Sewage Sludge:

- Total Energy Content: app. 23,000,000,000 MJ/a
equivalent to
- Natural Gas: app. 500,000,000 m³/a
- Diesel (fuel): app. 600,000 m³/a



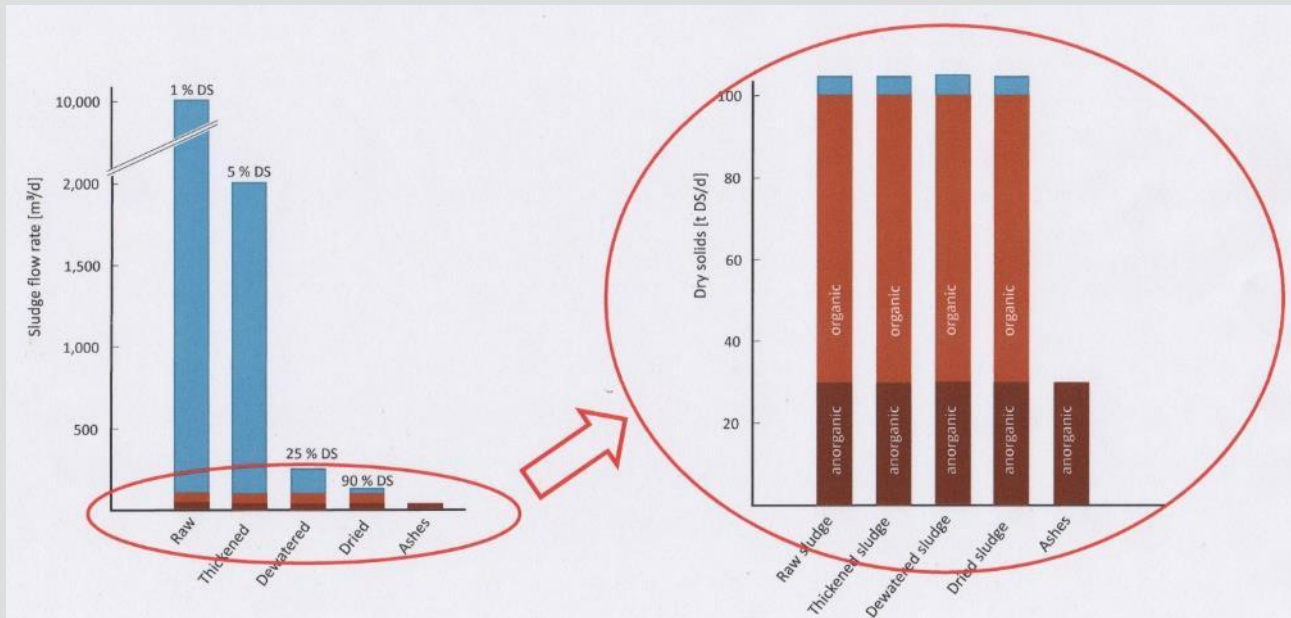
Source: Wikipedia.org



Source: maritime-connector.com

Sewage Sludge Composition without Digestion

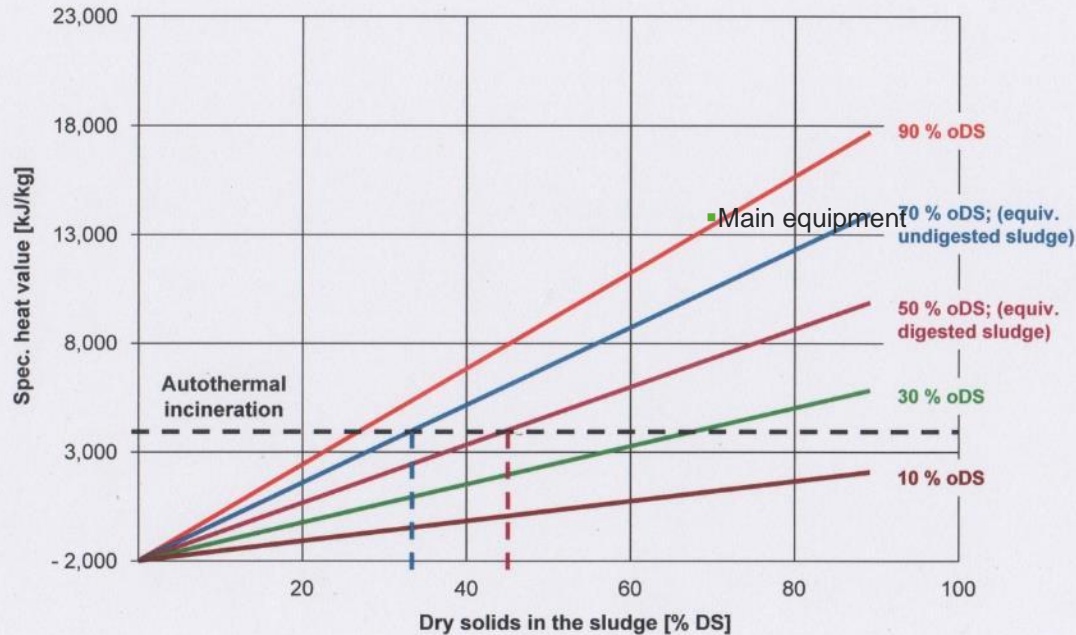
Basis: 100 tDS/d with 70 % oDS; equiv. to WWTP with app. 400,000 m³/d dry weather inflow



Total organic content of sludge does not change in the individual sludge handling processes, including sludge drying.

The entire sludge energy content can be transferred into electricity and thermal waste energy (heat) in a sludge incineration plant.

Autothermal Incineration



For sludge incineration without add. external fuel (autothermal incineration), the incinerated sludge is required to have a specific heat value of more than 4,000 kJ/kg DS.

For autothermal incineration of undigested sludge a dryness of app. 33–38% DS is sufficient.

Tubli Water Pollution Control Centre, Bahrain

Sludge to Energy

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Client: Ministry of Works, Kingdom of Bahrain
Period: 09/2007 – 12/2017

Project data:

- Expansion and rehabilitation to 400,000 m³/d
- New STP with deep lifting station, sand & grit removal, SBR, filtration, Ozonation and sludge incineration

Sludge Incineration:

- Currently sludge is dried to 90% and disposed off in local landfill – capacity approx. 45 tDS/d
- New sludge treatment with dewatering, drying and incineration of up to 118 tDS/d
- Electrical energy approx. 15 GWh/a
- Reuse of dried sludge as fertiliser possible



Tubli WPCCC - Location

Located in the Middle East - Kingdom of Bahrain

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Tubli WPCW

Overview Existing STP

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Plant History, Current Load & Condition

Plant History:

■ Phase 1 – Initial Construction of Tubli WPCCC	1982	54,000m ³ /d
■ Phase 2 – First Expansion of Tubli WPCCC	1989	124,000m ² /d
incl. Phase 1 Tertiary Treatment for Treated Sewage Effluent(TSE)	1989	60,000m ³ /d
■ Phase 3 – 2 nd Expansion of Tubli WPCCC	2002	200,000m ³ /d
incl. Phase 2 – TSE	2002	200,000m ³ /d
■ Phase 3a – Sludge Dewatering and Drying Plant with Thermal Drying	2004	32 tDS/d
■ Phase 3b – Short Term Measures 1&2: refurbish major plant components, increase sludge treatment capacity, install HYBACS system with 2 stage bio-reactors to increase treatment capacity, major concrete refurbishment work	20010-2017	230,000m ³ /d ~50 tDS/d

Current Load & Condition:

- Plant receives 300,000-320,000 m³/d
- Plant is heavily overloaded
- Several Parts of the STP have exceeded their lifetime and are in poor operating condition
- Result: discharge of partially treated wastewater to nearby Tubli Bay

Tubli WPCCC

Expansion Project

Expansion Project Parameters:

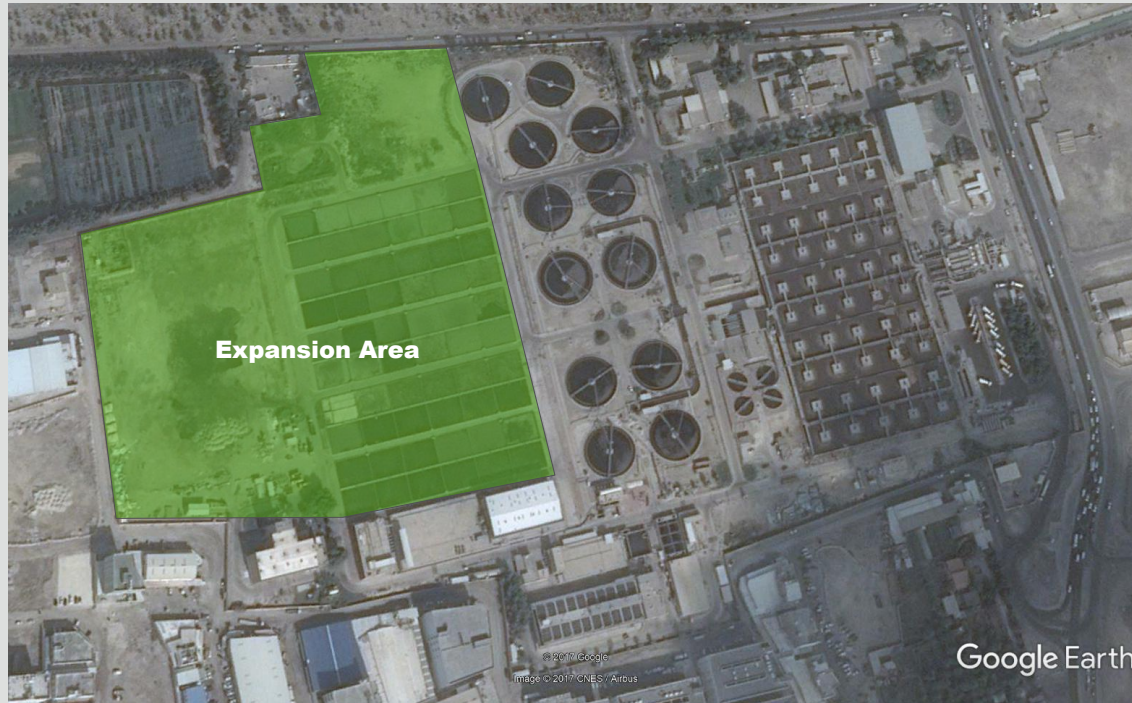
■ New Headworks with 20m Deep Lifting Station for	400,000m ³ /d
■ New Biological Treatment with SBR for	200,000m ³ /d
■ New 2 Stage Tertiary Treatment with Disc & Sand Filtration, 2 Stg. Ozonation	200,000m ³ /d
■ New Sludge Treatment incl. Incineration and Energy Recovery for	118 tDS/d

Expansion Project Timeline:

■ Consultancy Tender for Expansion DBO Tender	2007
■ DBO Tender Ready for publishing Budget Crisis did not allow for tendering	Oct. 2008
■ STM-1&2, HYBACS	2009-2017
■ GCC Funding for Expansion in	2012
■ Feasibility Study completed	2013
■ Tender Documents Expansion Phase 4 completed	2014
■ PQ and Stakeholder Approvals	2015
■ Tender published and tendering	2016
■ Tubli STP Expansion Phase 4 Award	Dec. 2017
■ Expansion Completed	2021

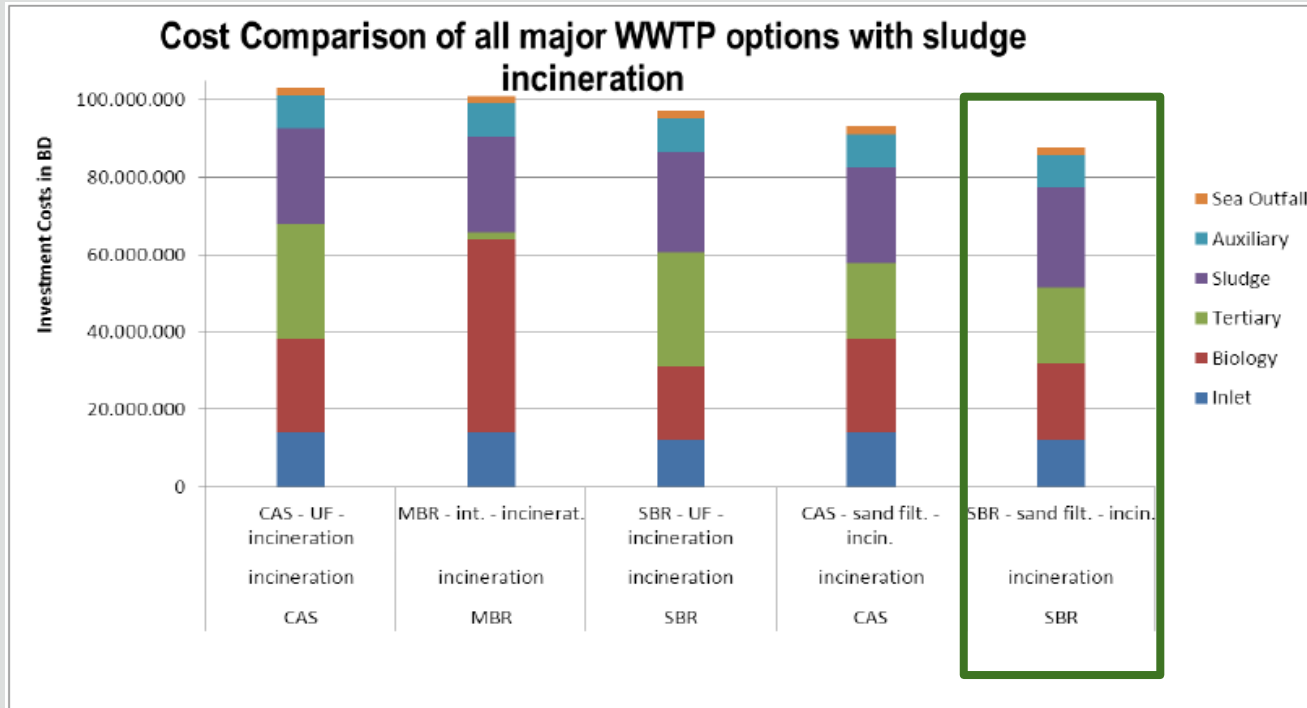
Tubli WPCCC Expansion Project

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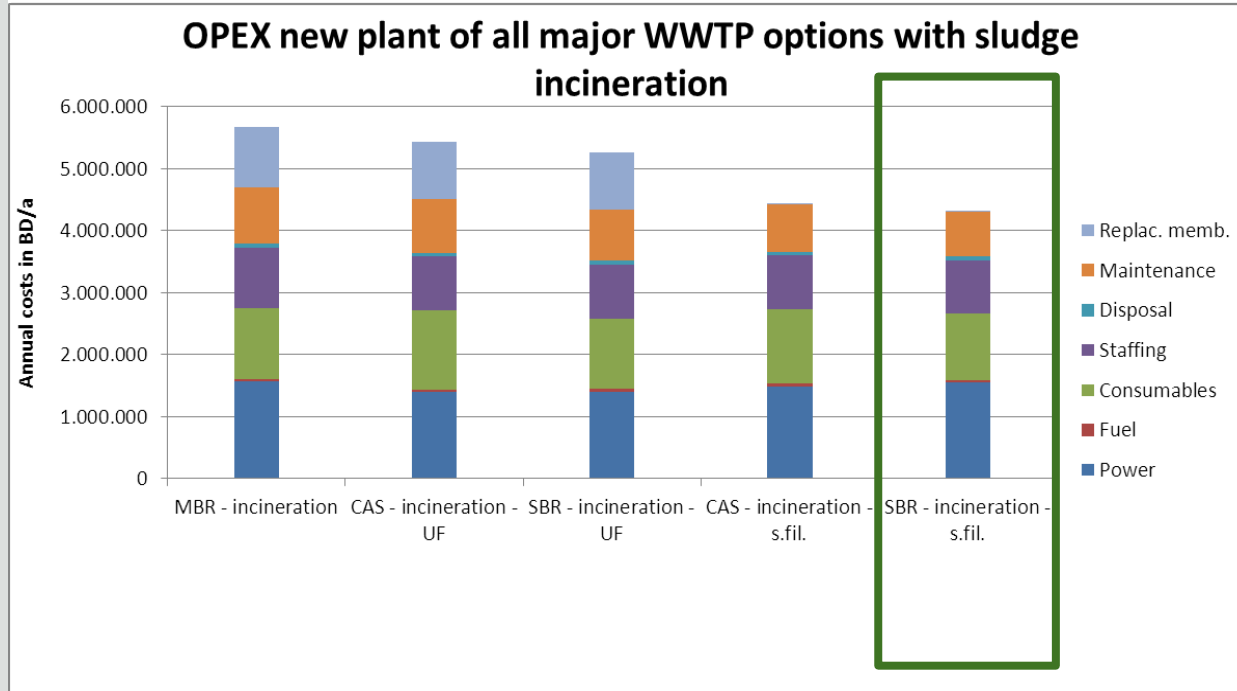
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Expansion Project – Feasibility Study



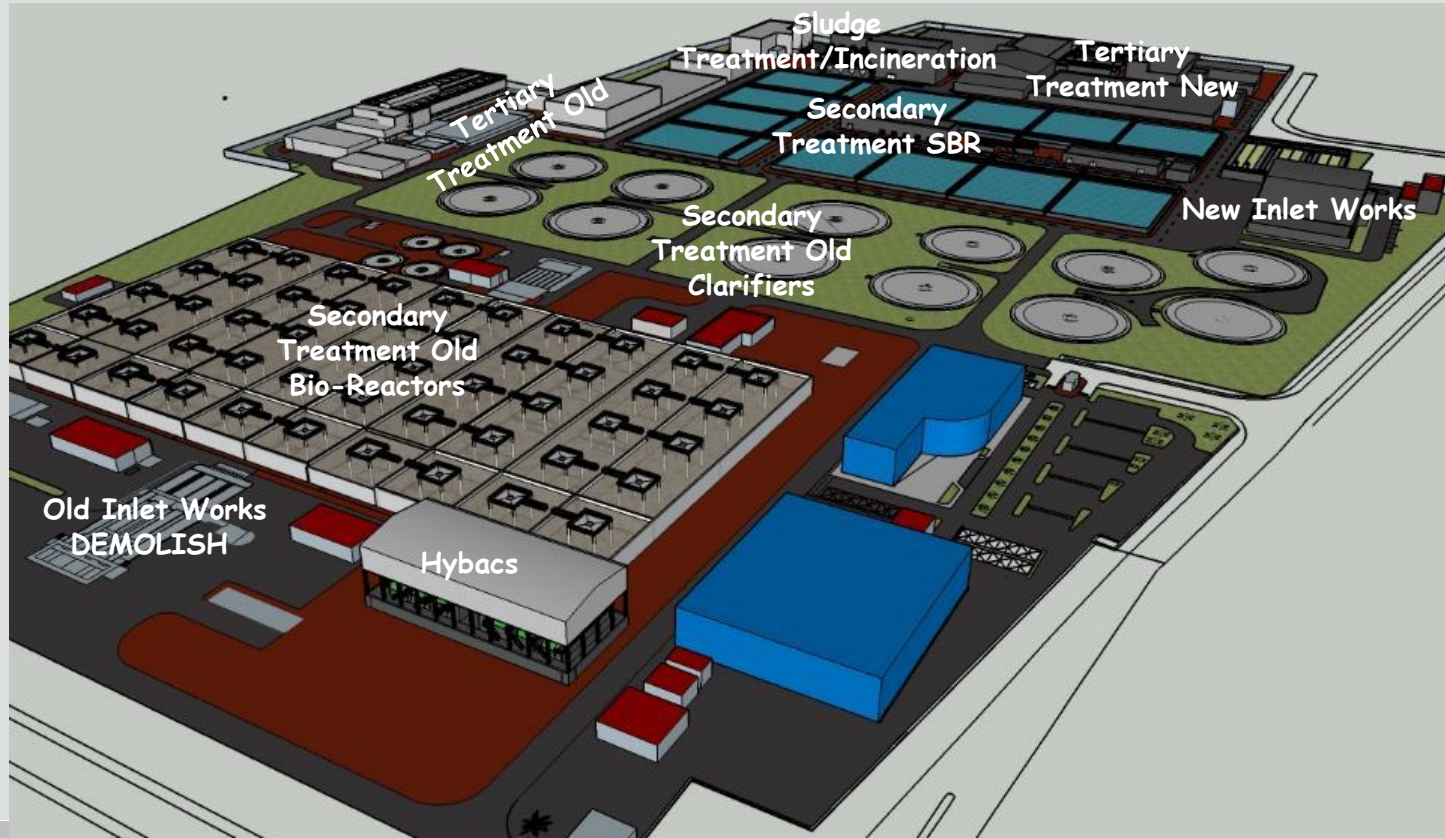
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Expansion Project – Feasibility Study



Tubli WPCCC Expansion Project

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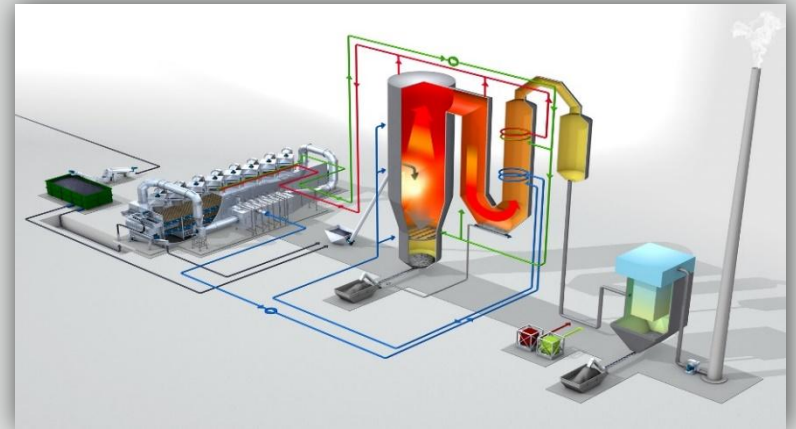
Tubli WPCCC Expansion Project

Sludge Treatment – Basic Concept

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Sludge Dewatering, Drying and Incineration:

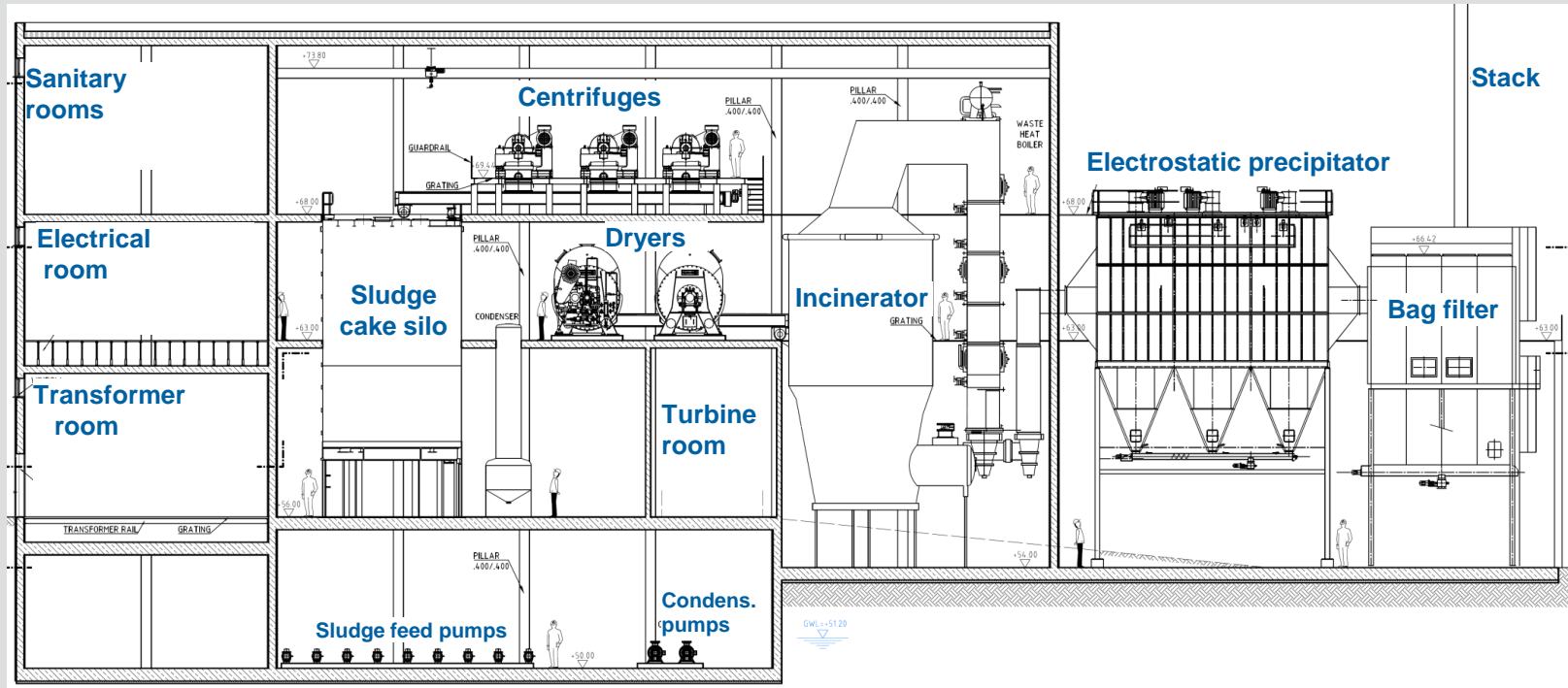
- Plant capacity: 118 t DS / d
- Solid content raw sludge: 0.8 % DS
- Raw sludge flow: 615 m³/h
- (Thickening by Micro-floatation: 1 line)
- Dewatering by centrifuges: 6 lines
- Solid content after dewatering: > 24 %
- Partial drying for autothermal incineration: 2 lines
- Solid content after drying: app. 38% DS
- Incineration in fluidized bed incinerators: 2 lines
- Steam turbine for electrical power generation



Tubli WPCC Expansion Project

Sludge Treatment – Process Overview

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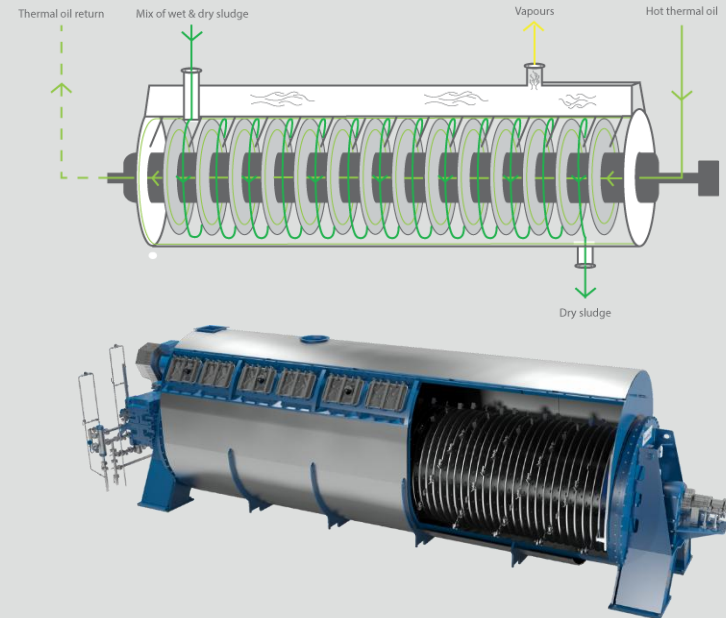
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Sludge Treatment – Process Step: Partial Drying

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Main equipment:

- Dryers: 2
- Type: Disc
- Heat medium: steam
- Evaporation: > 4,500 kg / h
- Disc surface: > 300 m²
- Solid content inlet: > 24 % DS
- Solid content outlet: > 38 % DS
- Steam boiler: 1
- Capacity: app. 4 MW
- Steam pressure range: 6 – 10 bar
- specific water evaporation: 15 kg /m² at 10 bar



Steam Dryers to utilise excess heat from incinerator flue gas

Source: haarslev.com

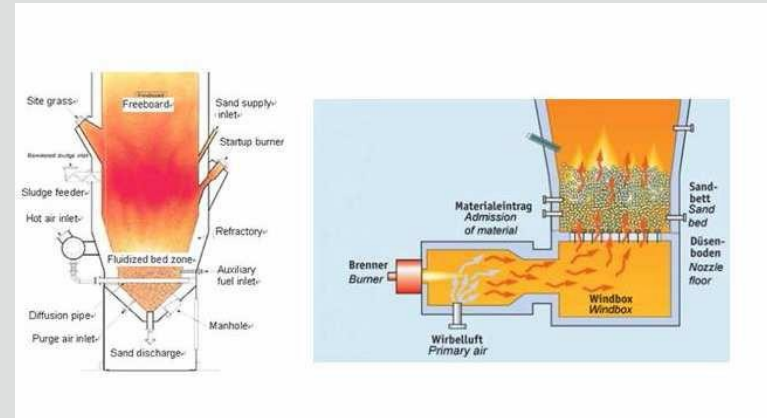
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Sludge Treatment – Process Step: Incineration

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Main equipment:

- Incinerator: 2
- Type: Fluidized bed
- Capacity sludge: 59 t DS / d (each)
- Inlet DS: approx. 38% DS
- Heating-up burning chamber: 2
- Fluidized air fan: 2
- Waste steam boiler: 2
- Steam pressure (minimum): 40 bar



Source: a4academics.com

Exhaust Heat from flue gas will be utilised for drying and power generation

Tubli WPCCC Expansion Project

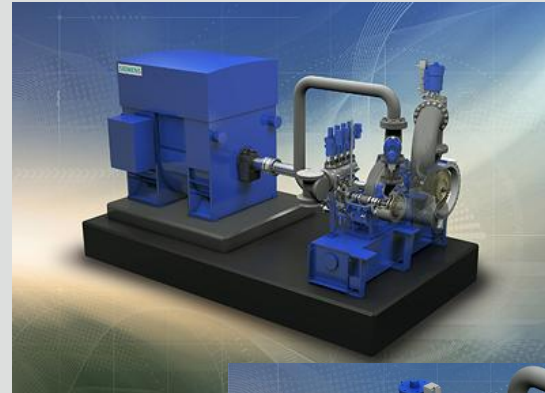
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Sludge Treatment – Process Step: Power Generation

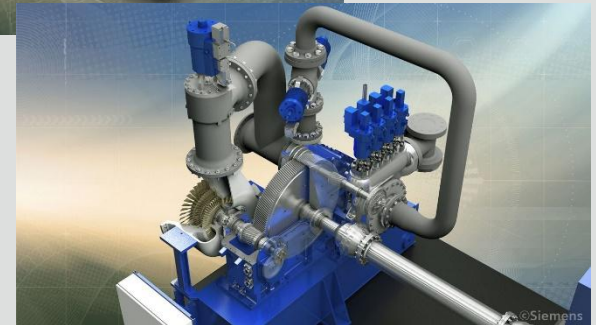
Main equipment:

- Boiler: 2
- Type: Horizontal / vertical
- Pressure level: 40 bar
- Temperature: 400 °C
- Turbine: 1
- Type: backpressure steam
- Generator: 1
- Capacity: 1.7 MW

- Power Generation: 40 MWh/d, 15 GWh/a



Source: siemens.com

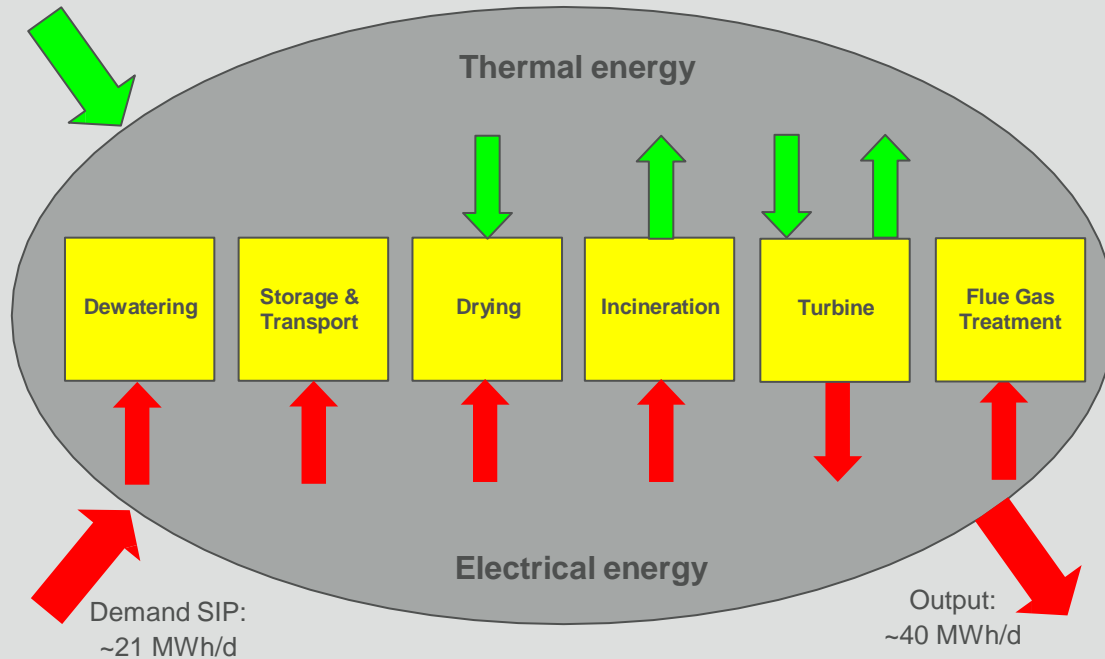


Exhaust Heat from flue gas will be utilised for drying and power generation

Tubli WPCCC Expansion Project

Energy Balance

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Total Tubli WPCCC:

- Demand Load: 30 MW
- Power Consumption: 380 MWh/d
- Power Generation: 40 MWh/d
- Covers 10.5% of Demand
- Covers 12% of STP Demand (without inlet LS)
- Covers up to 16% of STP Demand after rehabilitation of ex. STP (replace aeration, add. filtration, reduced Ozonation)

SIP Produces about 2 times Power it consumes

Sludge to Energy

The Green Alternative to current Sludge Treatment

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- Discover Sewage Sludge as a Resource not a Waste Product
 - ⇒ Sludge is an Energy Source
- Diversify sludge treatment and reuse options
 - ⇒ Stop landfill disposing of dewatered/ dried sludge
- Implement sustainable sludge management strategies
 - ⇒ Safe reuse in agriculture & landscaping
 - ⇒ Sustainable reuse:
 - as Fertilizer,
 - in Construction, as ad-mixture in concrete, asphalt, etc.
 - ⇒ Maximise energy recovery
 - ⇒ Nutrient/ Phosphorus recovery



Picture Source: lib.uts.edu.au

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Vielen Dank Thank you 谢谢 Merci شكراً

