



# Solar Drying - Sustainable Biosolids Management

SAWEA, February 13, 2020

# Why Dry Sludge?

- Volume Reduction
- Generate a Stable End Product
- Disposal options breaking away
  - Reduction of Landfill space
- Create a better product for Land Application
  - Better handling
  - Higher grade for fertilizer use (Class A / B)
- Beneficial Reuse
  - Use as Fertilizer
    - High nutrient value
  - Use as Biofuel
    - 11 - 15 kJ/kg (Equivalent to brown coal)

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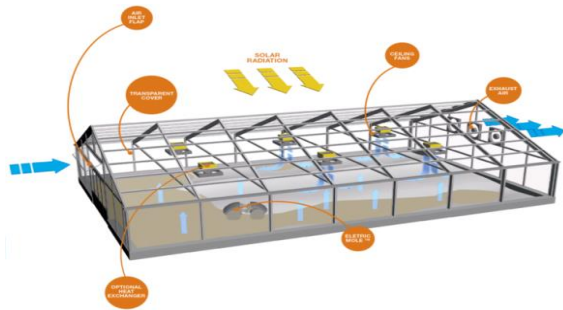


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# Why Solar Drying?

## Solar Drying



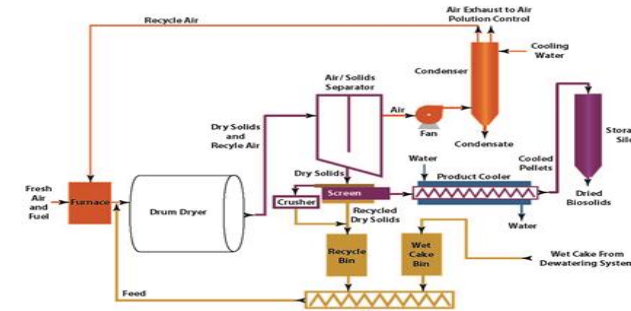
- Simple Operation - low skill operator
- Less moving parts - low maintenance
- Low Temperature - No Risk of Fire or explosion
- Simple Exhaust Air Treatment
- No return stream of condensate to head of plant
- 25 kWh to evaporate 1 ton of water
- Thermal energy is provided by the sun

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## Thermal Drying



- Complex Operation - highly skilled operator
- More moving parts - high maintenance
- High Temperature - Risk of Fire or Explosion
- Complex Exhaust Air Treatment
- Return stream of condensate to head of plant
- 25 kWh to evaporate 1 ton of water
- 850+ kWh of oil or gas equivalent to evaporate 1 ton of water

# Solar Drying

Outside View



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Inside View





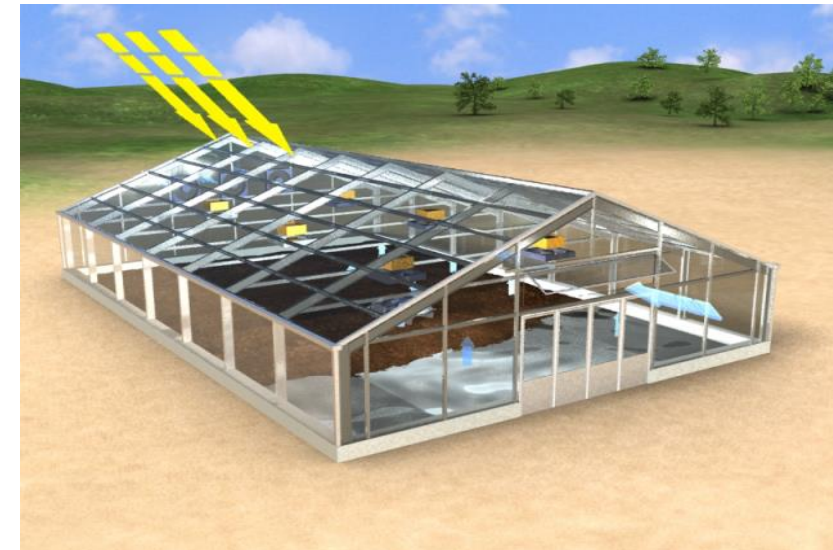
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# The Principle of Solar Drying

- Effective use of ambient conditions
  - Solar radiation & ambient air
- Best possible "conditioning" of the sludge
  - Avoid dry surfaces & anaerobic conditions
  - Optimize structure of the sludge
- Manage environment inside the drying chamber
  - Heat gain, heat loss & weather protection
    - Drying chamber
  - Air exchange
    - Exhaust fans & air inlet
  - Air speed & air distribution
    - Internal fans
  - Sludge conditioning
    - Turning Device





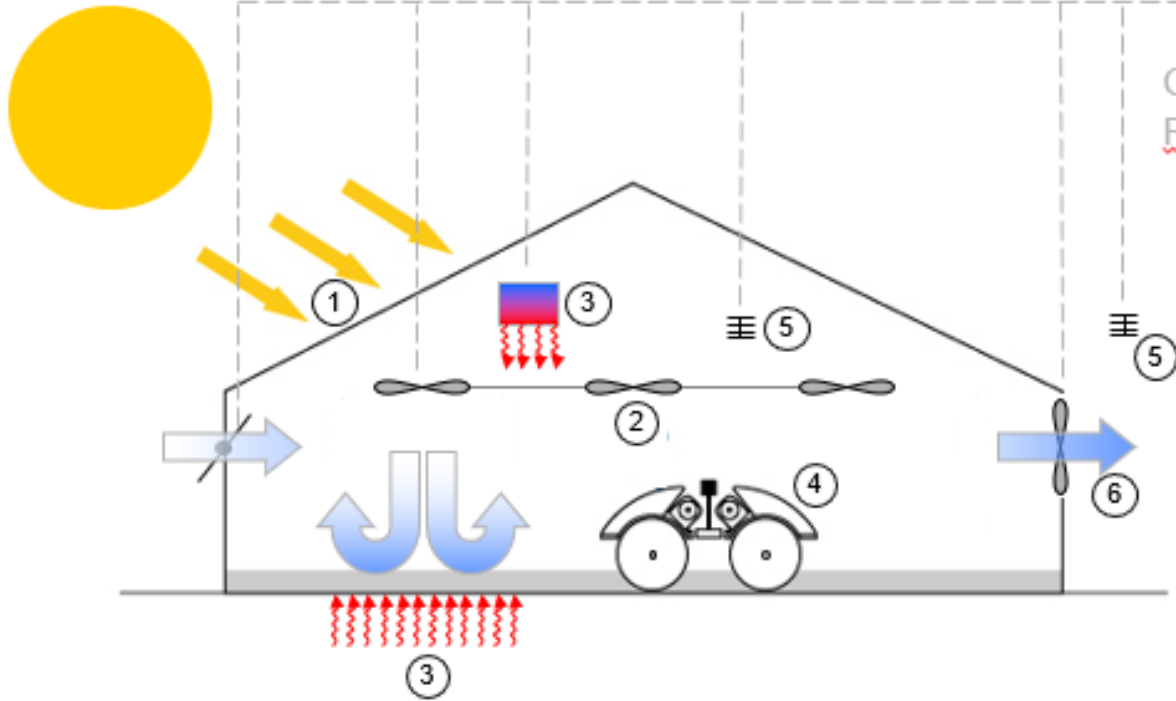
SPS with Touch-Display



Climate Control  
RemoteSupervisionSystem

# The Principle of Solar Drying

- ① Transparent covering
- ② MoviVent aeration System
- ③ Optional air and/or floor heating
- ④ Turning Device
  - Electric Mole
  - SludgeManager
  - OpenBed - Machine



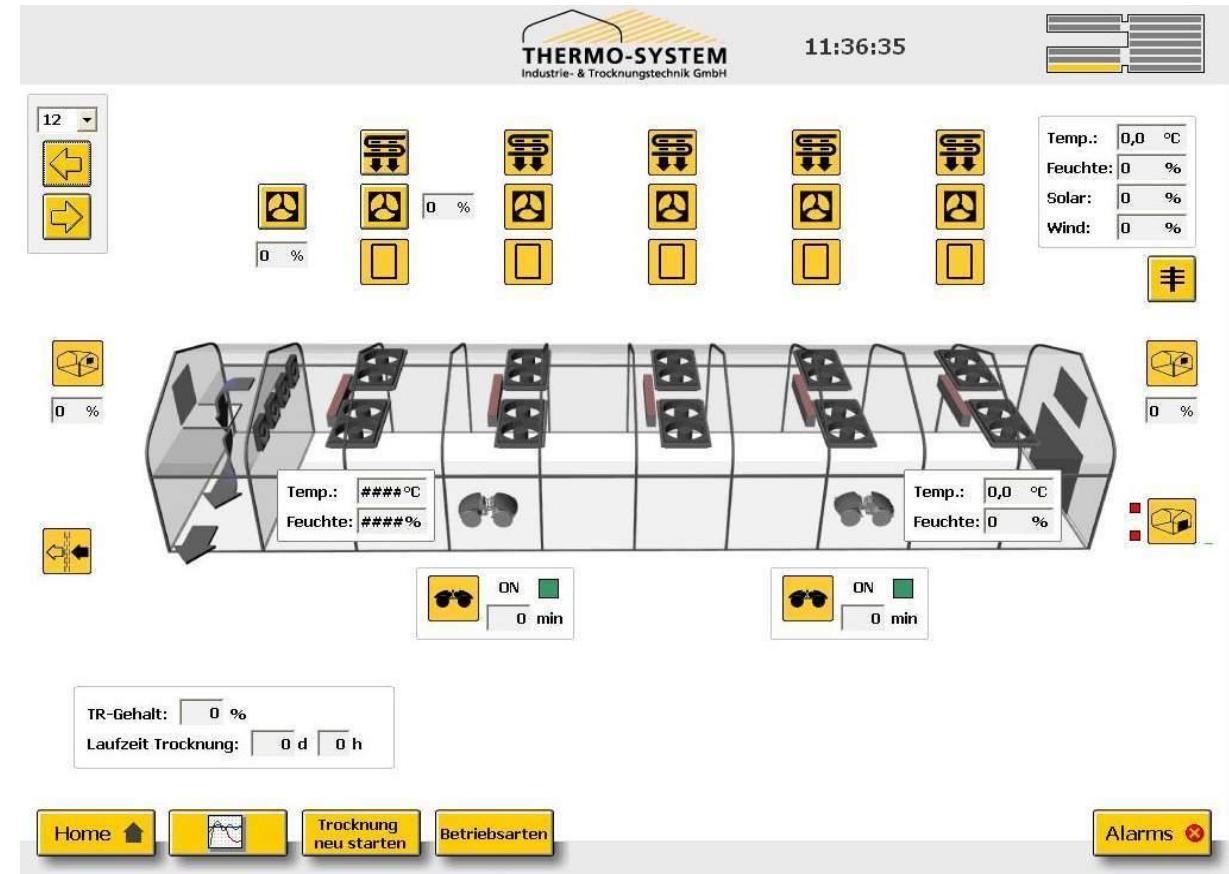
- ⑤ Sensors
- ⑥ Exhaust fans

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# Process Control

- Fully Automated Drying Process
  - Minimal operator intervention
  - Proprietary drying algorithm
- Full Process control
  - HMI
  - Scada tie-in
  - Remote Supervision



# Types of Solar Dryers

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## ➤ Batch Solar Dryers:

- The most applied solution
- Loading in batches
- Simple and Operator Friendly



## ➤ Continuous Solar Dryers:

- Fully automated loading and unloading
- More complex and higher maintenance





# Thermo-System Technology

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- German Solar Sludge Dryer Manufacturer
- Very Experienced
  - 250+ Solar dryer installations on 6 continents
  - 500+ Sludge turning devices in operation
  - 60% of all commercial solar sludge drying installations
  - 75% of all solar dried sludge
  - Global market leader
    - Solar drying since 1997
    - Extensive scientific research
  - The only supplier with multiple turning devices and a thermal Belt dryer in their portfolio

# Al Aweer, Dubai

- Continuous

- Start up 2016
- 83,000 t/a (230 t/d)
- 31,000 m<sup>2</sup>
- 16 turning machines

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# Marrakech, Morocco

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- Batch Process

- 75,000 t/a (205 t/d)
- 42,000 m<sup>2</sup>
- 28 Electric Moles





# Ras Laffan, Qatar (Shell Pearl GTL)

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- Batch Process

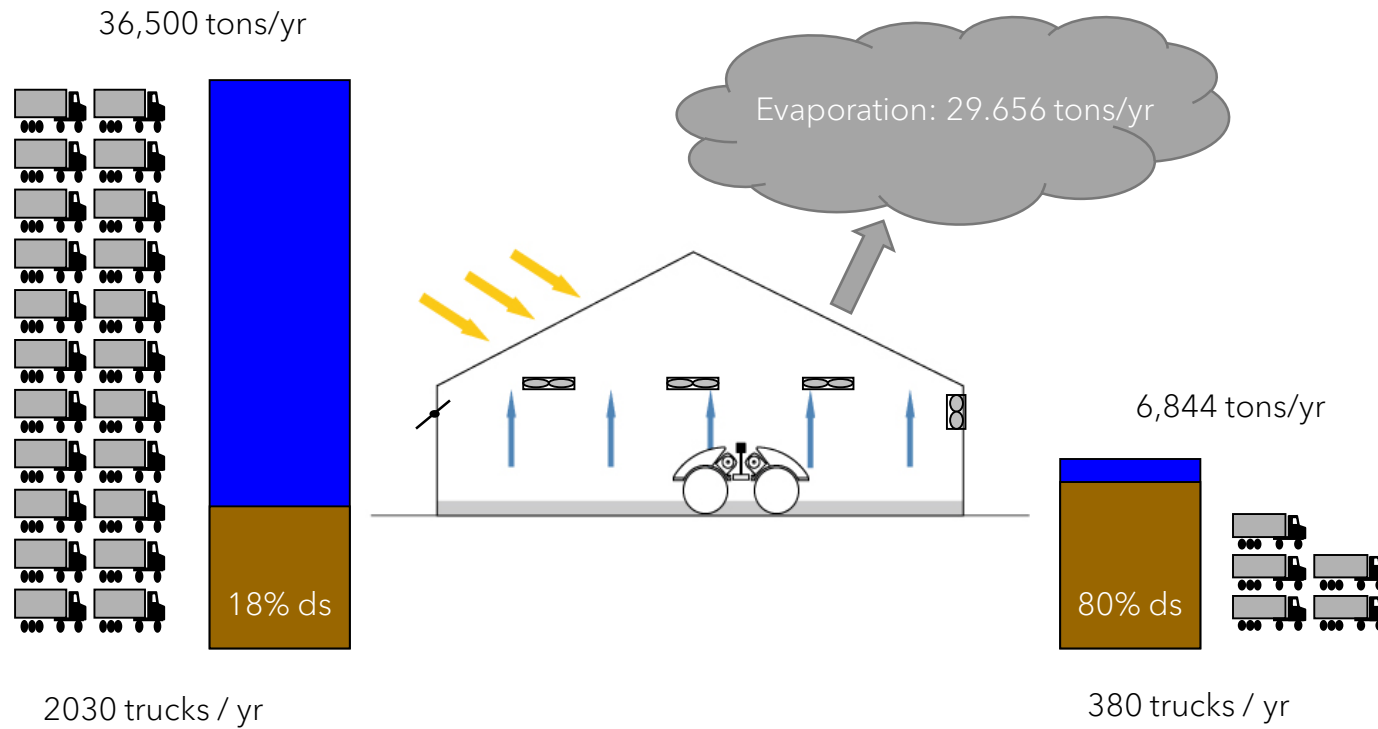
- Industrial Sludge
- 36,500 t/a (100 t/d)
- 20,088 m<sup>2</sup>
- 19 Electric Moles
  - (1 spare)
- 3.3 tons / hour H<sub>2</sub>O Evaporation





# Ras Laffan, Qatar (Shell Pearl GTL)

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# Sludge Handling Cost Savings

- Volume Reduction
  - Reduction of 1,650 trucks to landfill
  - Savings of ~ \$165,000 / year in hauling cost
  - Reduction of 140.25 tons CO<sub>2</sub> (assuming a distance of 100 kg to landfill)  
(85 kg CO<sub>2</sub> / truck / 100km)
  - Less Impact on Roads
  - Reduction of landfill costs by \$900,000
- In case of Shell the disposal of wet sludge in Landfill was banned completely

# Labor Requirement

- Completely Automated Process
  - Easy to operate (no special skills)
  - Loading by Containers & Unloading with Front End Loader

Loading



2 hours

Drying



Several weeks

Unloading



1 hour

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## Labor Requirement

|  |                                |  |
|--|--------------------------------|--|
| Total Sludge Production                | 36,500tons / year              |  |
| Initial Dry Solids Concentration:      | 15%                            |  |
| Final Dry Solids Concentration:        | 80%                            |  |
| Specific Density of Sludge             | 0.7t/m <sup>3</sup>            |  |
| Drying Chamber Area                    | 20,088m <sup>2</sup> / chamber |  |
| Sludge Filling Height                  | 0.2m                           |  |
| Amount of Sludge                       | 2,812t / batch                 |  |
| No. of Batches                         | 13batches / year               |  |
| Time Requirement Loading               | 2.0h / batch                   |  |
| Time Requirement Unloading             | 1.0h / batch                   |  |
| Total Time Requirement Sludge Handling | 39h / year                     |  |
| Time Requirement Process Monitoring    | 0.5h / day                     |  |
| Working Days                           | 312days / year                 |  |
| Total Time Requirement                 | 156h / year                    |  |
| Total Labor Requirement                | 195h / year                    | → 1 Operator , no special Skill Level Required |



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# Energy Requirements

|                              |   |
|------------------------------|---|
| Typical Energy Consumption   | 25 kWh / ton of water evaporated                        |
| Amount of Water Evaporated:  | 28,288 tons / year                                      |
| Estimated Energy Consumption | 707,200 kWh / year (electrical for entire Installation) |
| Price / kWh                  | \$0.08 US\$/kWh   |
| Annual Energy Cost           | \$56,576.00 US\$/year                                   |

All Required Thermal Energy for drying is provided by the sun, no additional cost generated

# Additional Benefits

- Simple Machinery
  - Easy to operate & maintain (no special skills)
  - No expensive spare parts to stock
  - 24h supervision not required
  - No condensate to treat or air scrubbing
  - Low Temperature - Non-EX Environment
- High level of redundancy
  - Sludge still drying in case of equipment failure
  - No critical system failures or plant shutdown
- Forgiving
  - Minimal impact of changes in incoming sludge quality
  - No issues with foreign objects

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# A Sustainable Solution

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## Environmental

- Reduced CO<sub>2</sub> emissions (utilizing solar energy for drying / less hauling)
- Generate a Biofuel with a positive energy balance
- No condensate flow back to head of plant
- Reduced odor emissions

## Social

- Low energy consumption
- Stable, Class A possible
- Safe technology
- Operator friendly

## Economic

- Reduced disposal & trucking costs
- Low O&M cost
- Marketable end product
- Proven technology (200+ installations)



Sustain  
the Future.



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# Questions?

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