Presentation Details	
Track Title	TRACK 5: Symposium on COVID-19 and Energy Sector
Session Title	Session 5.3: Covid-19 and the Energy Sector: Impacts on Different Economic Sectors
Session Date and Time	Thursday, 18 June | 2:00 – 3:30 pm
Presenter	Econas Sdn Bhd Khalid Bahsoon – Managing Director/Founder
Title of your Presentation	Medical Infectious Waste Changes

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What is Infectious Hazardous Waste

Types of Infectious Hazardous Waste to be treated

- **Infectious waste:** waste contaminated with blood and other bodily fluid
- **Pathological waste:** human tissues, organs or fluids, body parts and contaminated animal carcasses
- **Sharps waste:** syringes, needles, disposable scalpels and blades, sharp bins etc
- **Contaminated Waste:** Masks, Gloves, PPE **(COVID 19 specific)**

The major sources of health-care waste are:

- hospitals and other health facilities
- laboratories and research centers
- mortuary and autopsy centers
- animal research and testing laboratories
- blood banks and collection services
- nursing homes for the elderly

High-income countries generate on average up to 0.5 kg of hazardous waste per hospital bed per day

Low-income countries generate on average 0.2 kg.

Objective in treating Infectious waste & Types of Treatment

Objective

- Selecting safe and environmentally-friendly management options, to protect people from hazards when collecting, handling, storing, transporting, treating or disposing of waste.

Types of Treatment

- Microwave - Sterilisation
- Autoclave - Sterilisation
- Steam treatment integrated with internal mixing
- Medical waste incineration – Burning – ash residue
- Pyrolysis Systems

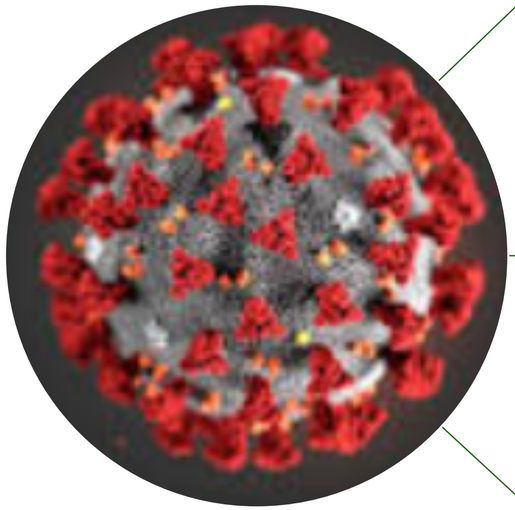
WHO’s view

- Where feasible, favouring the safe and environmentally sound treatment of hazardous health care wastes by autoclaving, microwaving, steam treatment integrated with internal mixing, and chemical treatment **over** medical waste incineration

Microwave

Autoclave

Needs and Issues due to COVID19



- **Sudden increase in waste volume – PPE – MASK – GLOVES**
- **More treatment facilities required**
- **Suppliers incapacity to supply equipment**

- Fast deployment required
- Flexibility of siting equipment
- Fast installation and training for operating equipment

POSSIBLE QUICK SOLUTION – DIRECT FEEDING OF RAW MEDICAL WASTE TO CEMENT KILNS ?

READY INFRASTURCTURE – QUICK DEPLOYMENT

POSSIBLE QUICK SOLUTION – DIRECT FEEDING OF RAW MEDICAL WASTE TO CEMENT KILNS ?

RAW Medical Waste DIRECT FEEDING to Cement Kilns with NO PRE-TREATMENT

NOT RECOMMENDED

- CEMENT FUEL ACCEPTANCE CRITERIA VERY STRINGENT
- FEEDING SYSTEMS WOULD NEED MODIFICATION
- STRICT REGULATIONS SOP
- CONTAMINATION RISK VERY HIGH PRIOR TO TREATMENT IN KILN

NOTE

AFTER CEMENT KILN TREATMENT MEDICAL WASTE IS

NO LONGER INFECTIOUS

Medical Waste SANITISIED BY PRE-TREATMENT - Residue to Cement Kilns as RDF/SRF

- Cement Fuel Acceptance criteria very stringent for RDF/SRF
- NO CONTAMINATION

OK

Other Solutions & Key Considerations for Technology Selection

- Technology maturity
- Proven
- Affordable – Capex and Opex
- Ease of use
- Consideration for Residue - ASH – RDF/SRF
- Meets regulations
- Fast deployment required
- Flexibility of siting equipment
- Fast installation and training for operating equipment

Technologies that potentially can meet the above criteria

Microwave	Autoclave

Mini-review Article

WM&R

Waste Management & Research
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Microwave as an emerging technology for the treatment of biohazardous waste: A mini-review

Klaus Zimmermann

Waste Management & Research 35(5)

World Health Organization

UNITED NATIONS

WHO & UN recommend to use technologies that don't consume valuable resources such as electricity, fuel, water

Technology Review Microwave vs Autoclaves – Klaus Zimmerman

Table 1. Advantages/disadvantages of conventional and sophisticated microwave technologies.

	Conventional microwave	Sophisticated microwave	Autoclave
Cost of device	Low	High	High
Energy consumption	Low	Low	High
Water consumption	None	Low	High
Control of inactivation process	Difficult	Very good	Very good

Table 2. Summary of the environmental aspects of treatment technologies (adapted from UNEP, 2012).

Technology	Air	Water	Solid residue
Autoclaves	x	xx	x
Batch microwave	x	x	x
Continuous microwave	x	x	x
Frictional heat	x	x	x
Dry heat treatment	x	x	x
Incinerators	xxx	xx*	xxx
Alkaline hydrolysis	x	xxx	x
Chemical	xx	xx	x

x: minimal concerns; xx: some concerns; xxx: significant concerns.
*Treatment of the incinerator's flue gas cleaning wastewater.

Table 3. Comparison of treatment costs of sophisticated microwave vs autoclave.

	Microwave	Autoclave
Assumed weight of waste/day	150 kg	
Accumulated weight of waste/year	54.75 tons	
Maximum of volume/run	60 L	80 L
Power input	6.5 kW	17 kW
Runs per day	12	10
Duration/run	45 min	70 min
Energy consumption/run	3.3 kWh	12 kWh
Energy consumption/day including standby	40.9 kWh	142.4 kWh
Assumed price/kWh	€0.2/kWh	
Energy costs/day	€8.16	€28.48
Energy costs/year	€2,978.4	€10,395.20

Conclusion: **Microwave technology was overall more environmentally friendly and more cost effective**

Recommended Process Flow

Medical Waste Input

Microwave

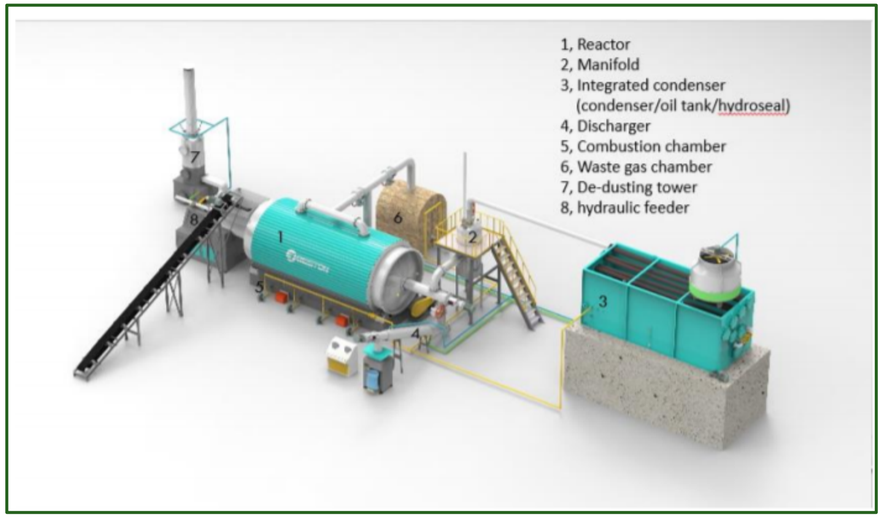
Autoclave

Medical Waste Residue

Recycling or final Disposal

Recycling of plastic residue
Pyrolysis – Plastic to oil
SRF/RDF Cement Kiln
Scheduled Waste To Energy
Sanitary Landfill
Secured Landfill

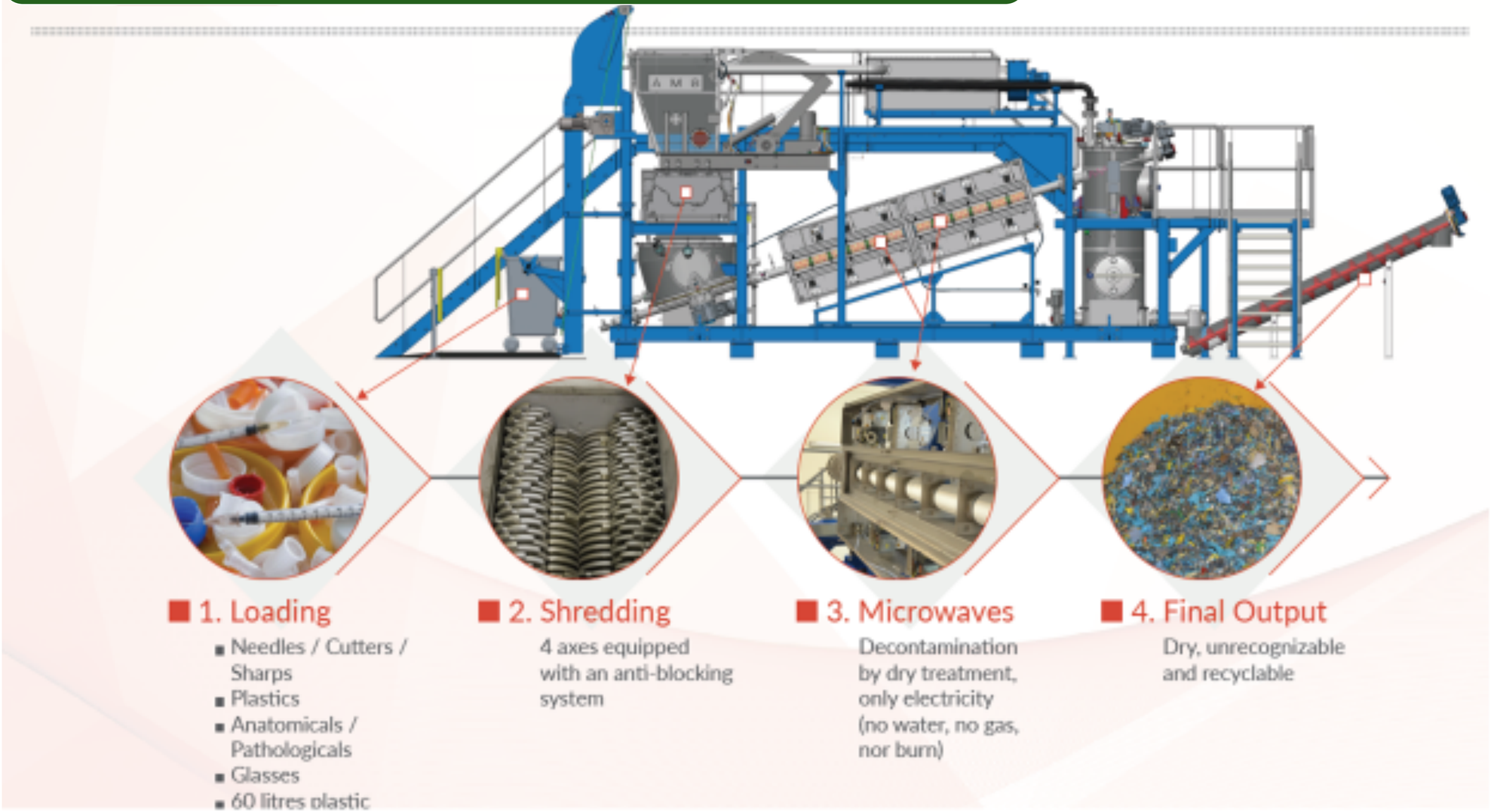
Pyrolysis System to Oil



Pyrolysis oil

Used and sold as fuel
Refine into
non-standard diesel

Flow-Diagram of Microwave System



Parameters: 100°C during 60 ±15 minutes to achieve 6 log 10 bacteria reduction.

Benefits / Advantages of Microwave Technology

Simple to use: automatic operations and continuous-flow process

Easy monitoring for operators - touch screen control panel

Spare parts **and local maintenance staff available**, tele-maintenance, remote and Internet monitoring and on-site quality control challenge (SCBIs)

Low environmental impact: no radiation, low odour, low noise and air emission controls

Eco-friendly : uses only electricity ; no waste water rejected ; no air emission, radiation, gas or chemicals

Easy to install and relocate ; requires 2 days for assembly and start-up

Volume reduction by more than 80% and up to 15% weight reduction

Waste output is dry, unrecognizable, decontaminated, homogeneous, potentially recoverable and recyclable

Automatic alarms and maintenance scheduled

Automatic weighting of containers and process capacities calculation

Temperature sensors, screw speed control & microbiological efficacy testing

Fast deployment and flexible siting

Case Study – Microwave supply - Malaysia

Two Units ordered from Europe – 250 kg per hour – 24 hours operation – 6,000 KG per day per Machine

Ready stock – shipment Europe to Malaysia

- Shipment from Europe to Malaysia 30 days
- Installation 10 days
- **Total days from order to installation 40 days**

Manufacturing from order

- Manufacturing time 40 days
- Shipment Europe to Malaysia 30 days
- Installation 10 days
- **Total days from order to installation 80 days**

MUST DO !!!!!

Prepare for the future to ensure Readiness for Fast Deployment

1) Identify technology and suppliers

2) Regional Manufacturing of Technology is important to ensure:

- Fast deployment
- Develop regional expertise
- Develop regional expertise for training, installation and operations
- Contribution to local economy

3) Flexible Technology – various available process sizes

4) Capacity availability of technology to meet needs

5) Ease of siting

6) Ease of operations

Questions and Answers

Thank You

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