European Experiences on Medical Management and Disposal

2021, May 25th - Tommaso Misiti

Agenda

- Snapshot on health-care waste
- Overview on waste disposal treatment during sanitary emergency
- Sanitary emergencies solved by co-processing in europe
- Focus on co-processing infectious waste
- Lessons learned

Snapshot on Health-Care Waste

Hazardous Health Care Waste

- Due to their nature, poor or **incorrect management** of the hazardous Health Care Waste, **can cause serious diseases for waste disposal workers and also the patients and the population in general**
- The littering or improper management of medical waste from hospitals can also lead to air, water and soil contamination **potentially effecting all forms of life**
- It can cause growth and multiplication of vectors like insects, rodents and worms leading to the **transmission of dangerous diseases like typhoid, cholera, hepatitis**

- Drug and Chemical Waste
- **Infectious Waste**
- Radioactive Waste
- Pressurized containers
- Genotoxic waste
- Wastes with high content of heavy metals

- The **infectious waste**, that can be contaminated with blood or body fluids, are the most dangerous waste for health people and environment
- They can contain a variety of pathogenic microorganisms that cannot be determined at the time a waste item is produced and discarded into a container and that if not well managed may enter the human body through several routes
- In many developing countries, this situation is exacerbate by severe climate conditions that makes the correct disposal of medical waste more challenging
- The presence of bacteria resistant to antibiotics and chemical disinfectants in medical facilities can be transmitted by subcutaneous introduction of the causative agent
- The emergence of COVID-19 has led to the increase of medical waste all around the world as well as household hazardous and plastic waste volume
- All the **waste produced related to COVID-19 activities, in health care facilities or patient home during quarantine, are infectious or potentially infectious**

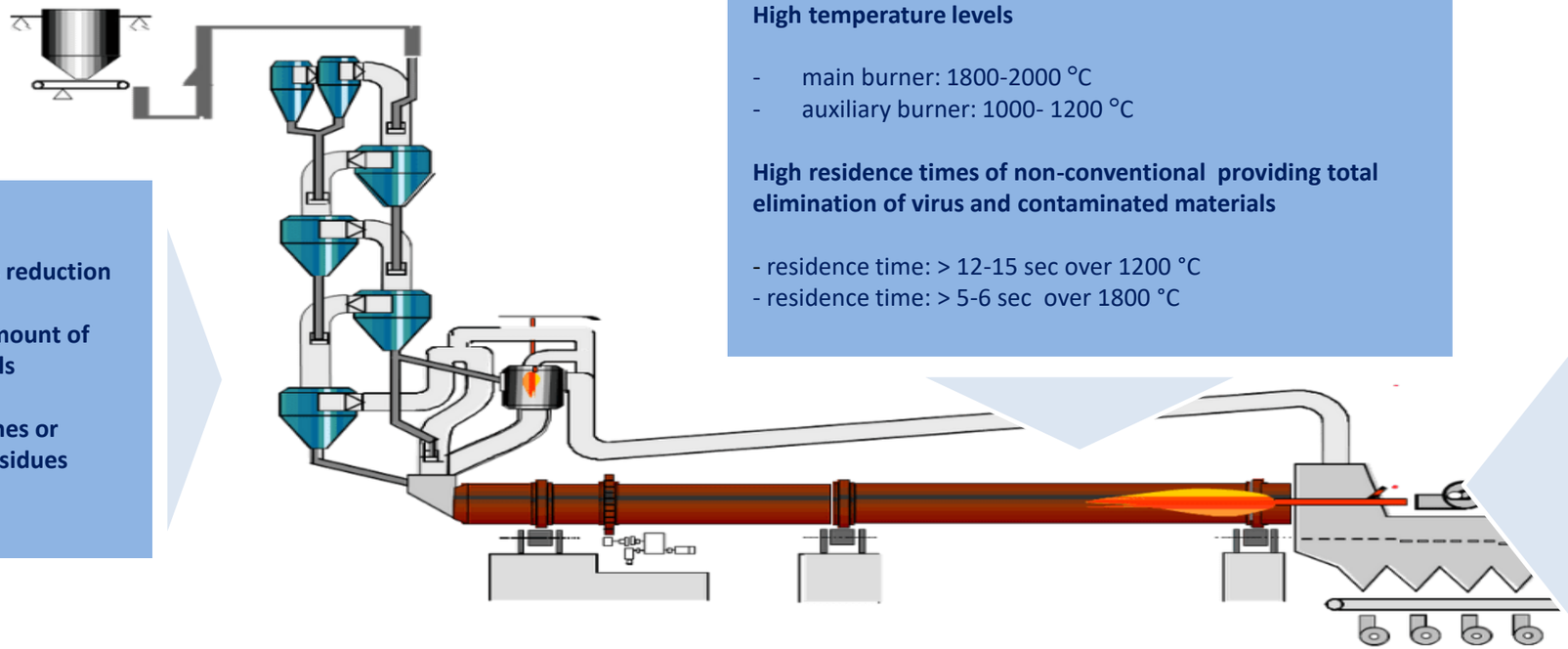
Overview on Waste Disposal Treatment During Sanitary Emergency

Chemical disinfection	Wet thermal treatment	Microwave	Inertization	Incinerator with rotary kiln	Single-chamber incineration	Pyrolytic incineration	Co-processing in Cement Kilns	Safe Burying/ Landfilling
- Highly efficient disinfection - Relatively inexpensive - Drastic reduction in waste volume	- Environmentally sound - Drastic reduction in waste volume - Low investment and operating costs	- Good disinfection efficiency - Drastic reduction in waste volume - environmentally sound	- Relatively inexpensive	- Adequate for all infectious waste, most chemical waste, and pharmaceutical waste	- Good disinfection efficiency - No need for trained operators - Low investment and operating costs	- Very high disinfection efficiency - Adequate for all infectious waste	- Saving fuel - Economic advantages for cement plant, waste producer and society - Low emission levels - Energy recovery	- Low costs
- Highly qualified technicians - Inadequate for some types of infectious waste	- Subject to frequent breakdowns - Qualified technicians - Inadequate for waste that is not steam-permeable	- Relatively high investment and operating costs - Potential O&M problems	- Not applicable to infectious waste	- High investment and operating costs	- Significant emissions of atmospheric pollutants	- Relatively high investment and operating costs	- Potential risk for workers - Cement production rate reduction	- Potentially dangerous for people and environment

Overview on Waste Disposal Treatment During Sanitary Emergency

Why Co-Processing?

- **CO2 emissions reduction**
- **Saving total amount of traditional fuels**
- **Absence of ashes or combustion residues**



High temperature levels

- main burner: 1800-2000 °C
- auxiliary burner: 1000- 1200 °C

High residence times of non-conventional providing total elimination of virus and contaminated materials

- residence time: > 12-15 sec over 1200 °C
- residence time: > 5-6 sec over 1800 °C

Determinant to guarantee effective incinerations of materials

- **High thermal inertia of the cooking system**
- **Good oxidation conditions**

The relevance of correctly manage infectious in co-processing

- **Mechanic access to the storage area (the medical waste need to be transported by self-emptying vehicles and mechanically loaded to the storage area)**
- **Good and totally closed storage area connected with the dispenser**
- **Efficient and modern filter to minimize emissions (such as bio-filter)**
- **Equipped control area to measure emissions**

Sanitary Emergencies Solved by Co-Processing in Europe

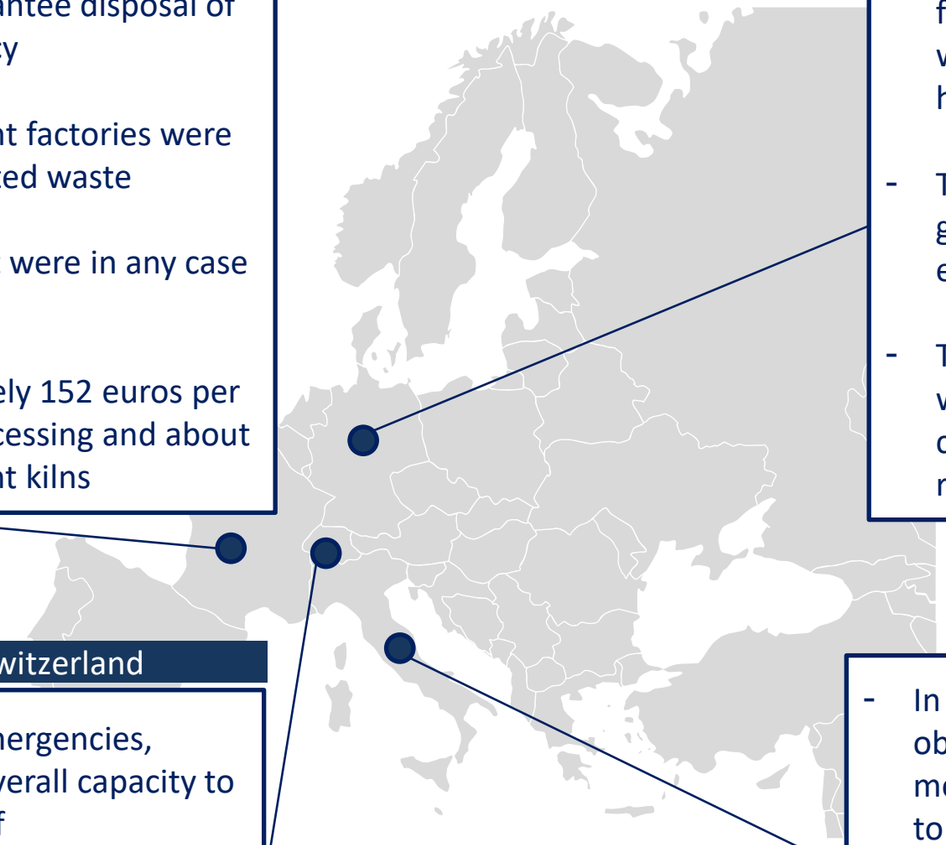
Infectious waste co-processing during "Mad Cow" emergency in Europe

France

- The capacity of incineration plants for hazardous substances was not sufficient to guarantee disposal of all animal waste during BSE emergency
- To help solve the emergencies, cement factories were authorized to treat temporarily, infected waste
- The absence of environmental impact were in any case guaranteed
- A state compensation, of approximately 152 euros per ton was foreseen for storage and processing and about 106.7 euros/t for treatment in cement kilns

Germany

- In Germany, during mad cow disease, part of the animal flours and fats were disposed in cement factories as fuel, with technologies capable of ensuring the protection of health and the environment
- The replacement of fossil fuel with this type of waste gives advantages both from an economic and environment
- The temperature in the combustion furnace is 1200 °C with a retention time of 8s, while in the post combustion chamber the temperature reaches 850 °C with a residence time of 2s



Switzerland

- In Switzerland, due to the entity of emergencies, existing plants do not had sufficient overall capacity to treat all animal meal to be disposed of
- During infectious spreading period, 45,000 t/y of animal meal was disposed of in cement plants, of which 20,000 t/y of flour of bones and 20,000 t/y of animal fats

Italy

- In Italy, during Mad Cow emergency, in order to face the obligation of co-incineration of potentially infected animal meal established by law 49/01, the cement plant started to burn animal meal instead of conventional fuel and petroleum coke normally used
- **The Italcementi Heidelberg Cement Group represent a success case of co-processing contaminated waste in cement industry during a sanitary emergency**

Focus on Co-Processing Infectious Waste

Case study of Italcementi Heidelberg Cement Group plant up-grading for infectious waste disposing

- The Italcementi Heidelberg Cement Group, has a production capacity of over 70 million tons of cement annually
- It is the fifth largest cement producer worldwide
- It operates in 22 countries in 4 continents of the world
- During Mad Cow emergency, to face the obligation of co-incineration of potentially infected animal meal started to burn animal meal instead of conventional fuel
- The cement plant located in “Sarche di Calavino” (Italy), not built for hazardous co-processing, need to provide some minor technical modifications in order to correctly dispose infectious waste minimizing risks for people and environment

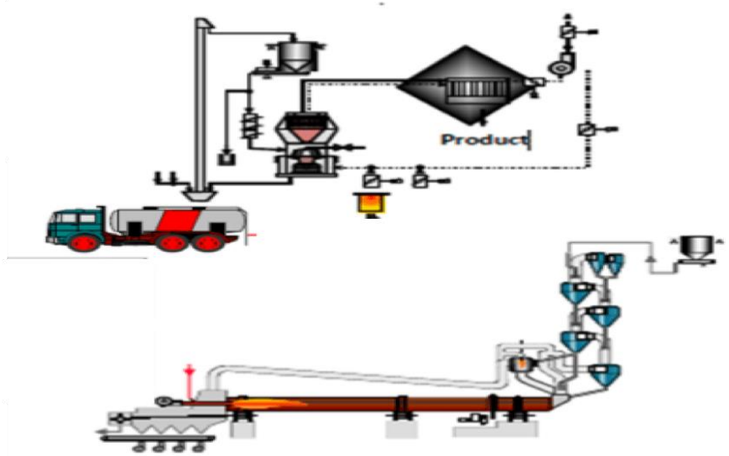
Focus on Co-Processing Infectious Waste

Case study of Italcementi Heidelberg Cement Group plant up-grading for infectious waste disposing

The infected waste was stored in a silo with flat bottom equipped with mechanical extractor, the capacity of which has been calculated to ensure a two/three days autonomy of plant's operation and ensure continuity of burning during potential periods of shutdown

The flours extracted from the silo fed, through a line of screw conveyors, a watertight weight loss dispenser

A series of screw conveyors and a terminal pneumatic transport enters animal meal to the line cooking by placing them in the rotating oven of the main burner at a temperature around 2000 °C.



To reduce the risk of spreading contagious, the plant is totally closed, and the points where there may be contact between the flours and the external environment are kept in depression

The air aspirated is sent to a bag filter and a bio filter for the elimination of any odours and from here sent to the cooking line for be used as secondary combustion air

This process guarantees that no emissions into the atmosphere are generated by the plant.

Focus on Co-Processing Infectious Waste

Case study of Italcementi Heidelberg Cement Group plant up-grading for infectious waste disposing

Investments for infectious waste co-processing

CAPEX

- Storage area → 3,000,000 -5,000,000 Eur
- Mechanical transportation belt (1000 meters) → 1,000,000 – 3,000,000 Eur
- Efficient and modern filter and emissions control system → 300,000 – 500,000 Eur
- Total → 4,300,000 – 8,500,000 Eur

OPEX

- Storage area → 80,000 – 100,000 Eur/year
- Mechanical transportation belt → 600,000 Eur/year
- Efficient and modern filter and emissions control system → 10,000 – 15,000 Eur/year
- Total → 690,000 - 715,000 Eur/year

Revenues from infected waste co-processing

FUEL SUBSTITUTION

- Animal meal: 3471.5 tons/year
- Pet coke saved: 8156.8 tons
- Cost of pet coke: 80 €/ton
- Total: 652,548 €/y

WASTE STREAM

- Government incentive: 150 €/t
- Total: 520,752 €/y

Elaboration on data available from Italcementi Heidelberg Cement Group

Lessons learned

- Correctly disposing medical waste is a key issue due to their hazardousness. Although **segregating waste at the source** is the most important step in managing medical waste, the ultimate safe **storage and final treatment** of infectious waste is crucial

- **Cement kilns** are capable of **disposing and safely treating wastes** including hazardous medical wastes such as persistent organic compounds and, in developing countries could be potentially part of the waste management infrastructure

- The main objective of a cement company investing in co-processing is to **reduce fuel and raw material costs**. The higher the costs for primary fuels or raw materials, the more attractive such an investment will be

- During **sanitary emergencies**, such as Covid-19 pandemic, when traditional disposal plant capacity are overwhelmed, cement kilns could be used. In that case, if cement plants are not suitable for co-processing, to manage hazardous waste, some **upgrading investments** are needed

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