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WASTE-02

Uranium-Containing Organic Solid Waste Volume Reduction

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Environmentally friendly technology that minimizes the weight and volume of uranium-containing organic solid waste generated from nuclear fuel processing facilities, and treats waste gases and waste liquids generated in the process harmless to the environment.

Description

● Background

Various types of radioactive wastes are produced while operating nuclear facilities such as nuclear power plant operation and nuclear fuel production. In particular, organic solid wastes such as work clothes, gloves, plastics and wood are low level radioactive wastes, but the decontaminate and measurement processes are difficult, most nuclear facilities are permanently disposing them instead of clearance. However, the permanent disposal costs a great deal, a volume reduction technology for organic solid waste is needed. In the case of incineration, organic solid wastes volume can be drastically reduced at a high temperature, but this method produces contaminants such as dioxin, and physical compression has a disadvantage that the volumetric capacity utilization is remarkably deteriorated. Therefore, there is a need to develop a technique for reducing radioactive and pollutant emissions that affect the environment during the volume reduction process as well as a technique for high efficiency in volume reduction.

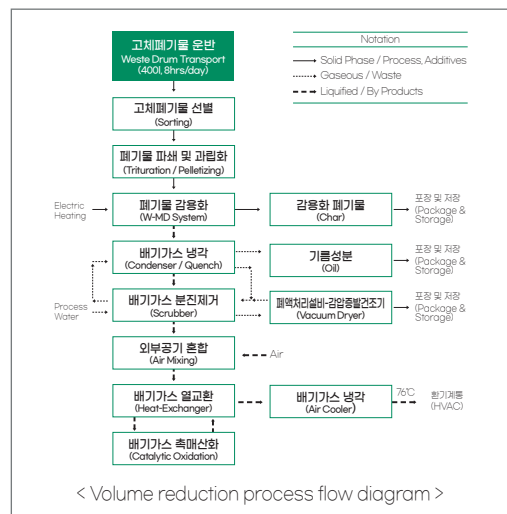
● Purpose and Necessity

- The disposal cost is high, radioactive wastes are produced more and more
- Reduce radioactive waste managing cost by reducing the volume extremely
- VR(Volume Reduction) ratio : Over 80% of

- miscellaneous waste and wood, over 50% of synthetic waste
- Strengthen safety and public acceptability by operating environment-friendly processes
- No harmful chemicals are produced such as dioxin and nitrogen oxides and less exhaust fumes are emitted by operating at low temperature compared to incineration
- Available to additionally reduce volume through physical compression(Pelletizing)
- Final VR ratio : Over 90% of miscellaneous waste and wood,

● System Configuration

- When the organic solid waste, which is mainly composed of organic material, is heated in the anaerobic environment at a temperature of 400~650°C, Char, a solid material mainly composed of carbon, and exhaust gas containing H₂, CH₄, CO, VOCs, etc. are generated. Char, minimized in volume and weight, is treated as a radioactive waste and exhaust gas is released to the environment at a harmless level to the environment.

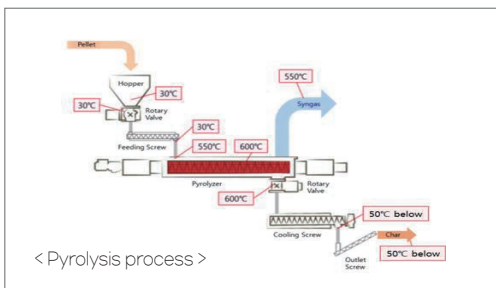


- Trituration and Pelletization step
 - Organic solid waste is triturated to 4 ~ 20mm size for uniformed heat supply
 - Pelletization at a density of 0.2 to 0.4 kg/ℓ in order to reduce the volume of triturated material, smooth the movement and increase the heat transfer efficiency



< Trituration and Pelletization results >

- Pyrolysis step
 - In order to make an anaerobic environment, nitrogen gas is injected
 - No combustion reaction occurs because it operates within 400 ~ 650 °C in the anaerobic environment
 - The internal temperature can be controlled by the heat transfer method using electric energy and the processing speed is automatically adjusted based on the amount of waste and the amount of exhaust gas generated



< Pyrolysis process >

- High-temperature by-products divided into syngas and char in solids separator

< Char >

(C₆H₁₀O₅)_n (Cotton, paper, wood)

-(CH₂CH₂)_n -(Polyester)

-(R-COO-R)_n -(Polyethylene)

-(CH₂-C(CH₃)=CH-CH₂)_n -(Latex)

+ Heat Energy =

H₂

O₂

N₂

CO

CO₂

CH₄

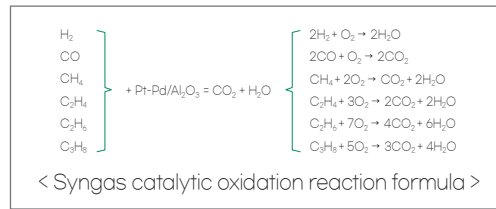
C₂H₄

C₂H₆

C₃H₈

< Types of Syngas generated after pyrolysis >

- Syngas catalytic oxidation step
 - Combustible substances such as CO, H₂, CH₄, and VOCs in the syngas are oxidized by a catalyst
 - It is converted to H₂O and CO₂ through oxidation reaction, and finally released harmless to the environment
- An additional volume reduction step for Char
 - Reduce inclusion voids and overall volume through physical compression(Pelletizing) without putting additives.



< Pelletizing Char >

Distinctiveness

• Characteristics

- Significant reduction(over 90% when pelletized) of organic solid wastes due to the application of high-volume capacity reduction technology
- The amount of exhaust gas generated by pyrolysis in the anaerobic environment is less than incineration and there is no generation of nitrogen oxides, which is advantageous for treatment
- No dioxin generation due to the low operating temperature(400~650°C) compared to incineration
- Exhaust gas and liquid waste generated during the process operation are controlled to be less than 50% of the environmental standard value, and emissions are minimized to the environment

• Applications

- Applied to uranium-containing organic solid waste generated in nuclear fuel processing facilities (Currently only physical compression is performed)
- Applied to waste of DAW(Dry Active Waste) in nuclear power plant operation and decommission.

• Benefits

- Stable operation of nuclear facilities by minimizing the storage of radioactive waste due to the volume reduction of organic solid waste
- Reduction of management cost

Experience

- It was applied to organic solid waste containing uranium

Deliverables

- Organic radioactive waste volume reduction process and secondary waste treatment technology
- Procedures and operation support for volume reduction process

Technology Readiness Level (TRL)

Actual system proven through operation

Business Model

Technology Transfer

Licensing

Joint Search

Service Execution

Others