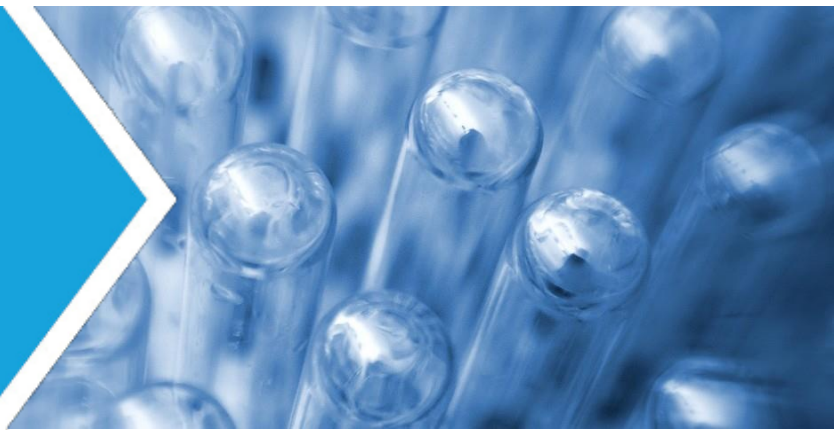
FACT SHEET

Recycling and Recovery of Polyurethanes



ENERGY RECOVERY

Energy embodied in PU in the form of chemical raw materials can be recovered in various types of energy production facilities. Examples include waste treatment facilities, such as municipal solid waste incineration plants (MSWI), or industrial boilers to produce steam or electricity for industry.

PU waste can be substituted for fossil fuels, such as coal or heavy fuel oil, or assist in waste treatment plants such as MSWI. Its four main operating objectives are: reduction of weight and volume, detoxification and inertisation of solid waste residues to make them suitable for environmentally sound landfill.

All types of PU applications in the various markets: building & construction, transportation, furniture and bedding, cold appliances and leisure, can be energy recovered. The different applications cover a broad product performance with a large variety of PU types from flexible to soft, from hard surfaces to rubber surfaces and from heavy rigid structures to light foam.

Mostly, PU is the material used to bond different types of materials together to form material hybrids – metal & plastics - or is used with other materials such as textiles and wood in design and construction. The characteristics of PU make it difficult to separate from non-PU materials either cost-efficiently or in high quality and homogeneity.

Technology

Description

The two main energy recovery types are the waste incineration and industrial boiler technologies. The waste incineration mass burn type uses the grate system design, which treats the overwhelming part of the European MSW. The fluidised bed technology is used in the waste incinerators (FBI) type as well as for fluidised bed boilers using many types of solid fossil fuels. Different types of FBI have existed for decades.

Technology Status

In Europe, MSW type incineration uses almost entirely the grate system design. Grate movement can be forwards or backwards and grate bars can be cooled by water or air. Through more than 50 years of operation, the grate system has proven that it is robust and reliable. The boiler and gas cleaning section is not specific for either one of the two technologies: FB or Grate.

All FB types are suitable to incinerate different types of PU waste. Ebara ICFB was selected in the late 1990s for the successful demonstration of the extremely demanding mono combustion of PU foam. In various other large or medium size equipment types, PU containing waste was successfully incinerated. Good temperature control through the circulating homogeneous sand bed leads to high combustion efficiencies, low unburned gas emissions and solid residues.

PU Specifics

Different large scale tests in industrial boilers of FB type have shown that controlled low NOx emissions can be achieved even with high N fuel content. The N content of the PU is rather high compared to other fossil fuels like coal, wood and paper. Good circulating conditions, proper air management of primary and secondary air as well

as the correct size reduction of the PU feed and location of feed point, positively achieve low NOx emissions as shown in various large scale demonstration tests.

MSWIs have operated safely and efficiently throughout the years using different PU articles such as mattresses, shoes and automotive shredder residue. Many large scale tests have also shown that PU EoL articles can be incinerated up to 5 wt % without a negative impact on emissions and operating results.

Important Technologies

The overwhelming market FB share has the stationary FBI and the circulating FBI. Besides these two conventional FB systems, a new technology, internal circulating fluidised bed, (ICFB) has emerged and seems especially attractive to be used for high calorific waste such as PU.

MSWI equipment suppliers and engineering companies are familiar with PU EoL foam through the many large scale demonstration tests, where some have been part of Martin and Noell.

Input Characteristics

A generic characteristic for the PU waste fed into energy recovery cannot be given. It is suggested that low contaminated PU waste with low amounts of inert materials should be treated in FB units. Rather highly contaminated PU waste such as end of life rigid PU foam from B&C applications are more suitable to MSWI with a moving grate system. This rather robust mechanical equipment can handle waste mixtures with up to 20 wt % solid inert materials e.g. adhering concrete, bitumen and gypsum to PU rigid foam.

Market & Costs

Waste characteristics, with respect to homogeneity, product contamination level and amount available, are the three key decision drivers to select the appropriate operator accepting the PU waste. Market prices accepting the PU waste vary widely and have swings and cycles like most industrial markets. Price levels to incinerate PU coincide with normal waste fuels or MSWI. Additional surcharges in the form of penalties to normal plastic mixed waste can be expected in the market. If capacities are tight then volumes are small and contamination levels are high. Price tags for PU waste do not exist in the market and customers should work together with responsible waste management companies.

The market size of power & steam production facilities is large in comparison to waste incinerator capacity. The huge capacity in fuel consumption for industrial production plants has so far not favourably affected price levels for waste fuels.

Ecology

Many different types of life cycle analysis with different plastic waste mixtures, representative for the main market sectors packaging, automotive and electrical appliances, have shown that high efficiency energy recovery technologies, such as cement/lime and power production as well as MSWI with combined heat and power recovery, are about equal. For material recycling, there is no environmental preference for highly contaminated waste.

Market Development/Limits

The growth of energy recovery facilities in the EU and the ever increasing demand of society for energy presently pose no limit to energy recovery. Landfill phase out regulations favour more energy recovery units to be built in the future. However, market growth of MSWI capacity is historically small at 2%.

Products

The largest product outlet of material recycling is re-bonded foam. Its relative high density and excellent resilience make it suitable for applications including vibration sound dampening, flooring, sport mats, cushioning, packaging and carpet underlay.

The quality of re-bond depends on several factors like types and grades of the foams used, particle size and uniformity of the shredded foam pieces, required density of the end product, quality of the binder and binder/foam ratio.

Boards made from automotive parts can have a wide range of properties. Those made from flexible integral skin parts form rubber-like mats, while RIM parts form elastic boards and headliners can be used to make stiff, self-supporting boards.

Conclusions

Energy recovery technologies are robust and are of a sufficiently large size to be able to treat many different types of waste plastic mixtures. This causes low emissions during transport, low logistical costs, little pre-treatment and handling efforts resulting in an eco-efficient waste treatment.

References

See Fact Sheet List of References and suggested Reading Material.

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