



RECYCLING
**PROPELLANT MEMBRANE
RECOVERY**

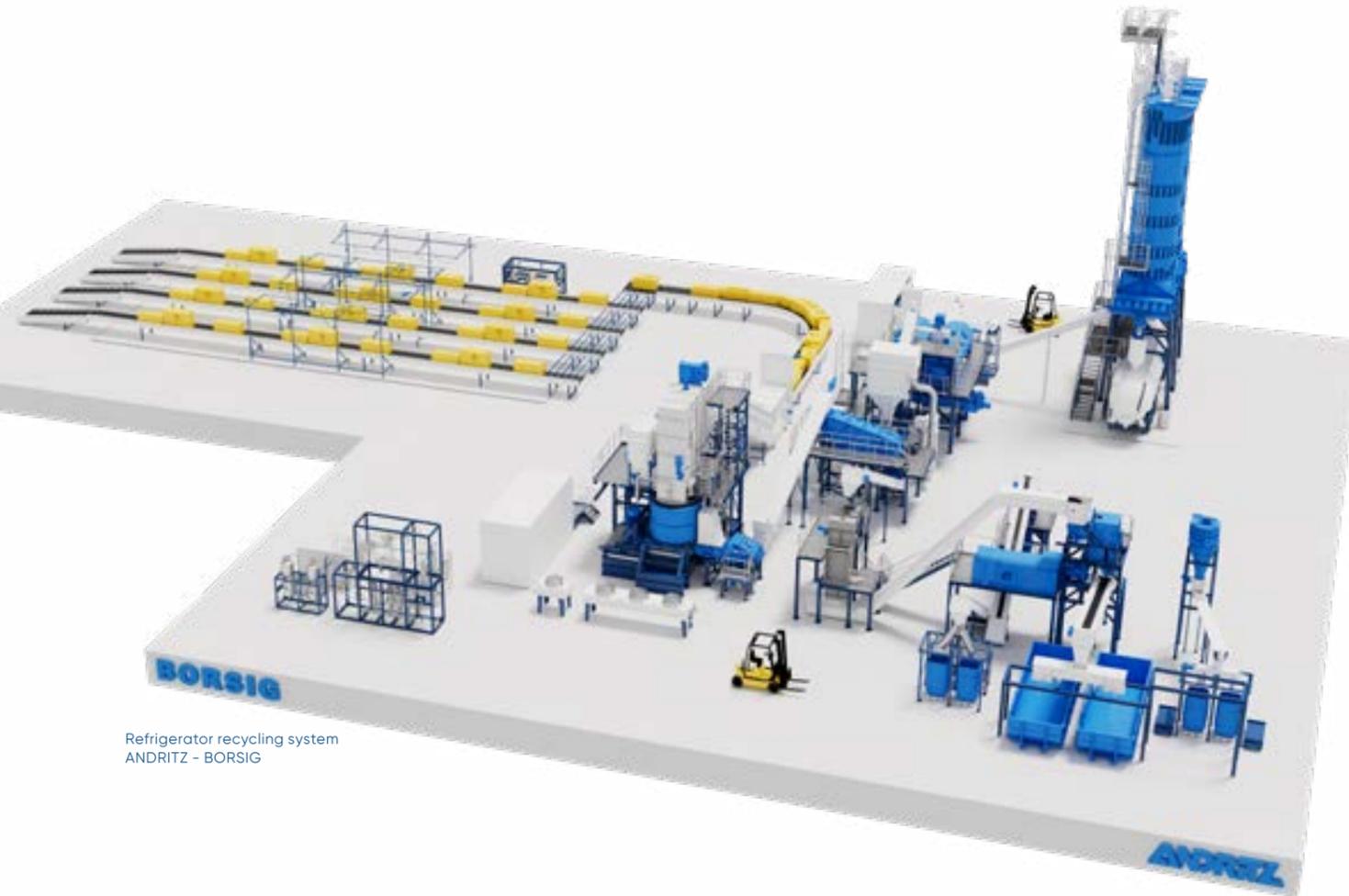
LOW OPEX - NO LIQUID NITROGEN

ANDRITZ

ENGINEERED SUCCESS

Revolutionizing refrigerator recycling

ANDRITZ is a major, well-known, experienced supplier of refrigerator recycling plants. BORSIG Membrane Technology is a provider of leading innovative membrane technology solutions for a wide range of industrial applications.



Refrigerator recycling system
ANDRITZ - BORSIG

Working together, the companies have developed a new propellant recovery unit, which has several benefits for recycling plant operators, particularly in terms of cost and ease of maintenance. The collaboration resulted in the Propellant Membrane Recovery (PMR), an innovative system with proven membrane gas process for safe, efficient, and reliable recovery and significantly improved lower OPEX structure.

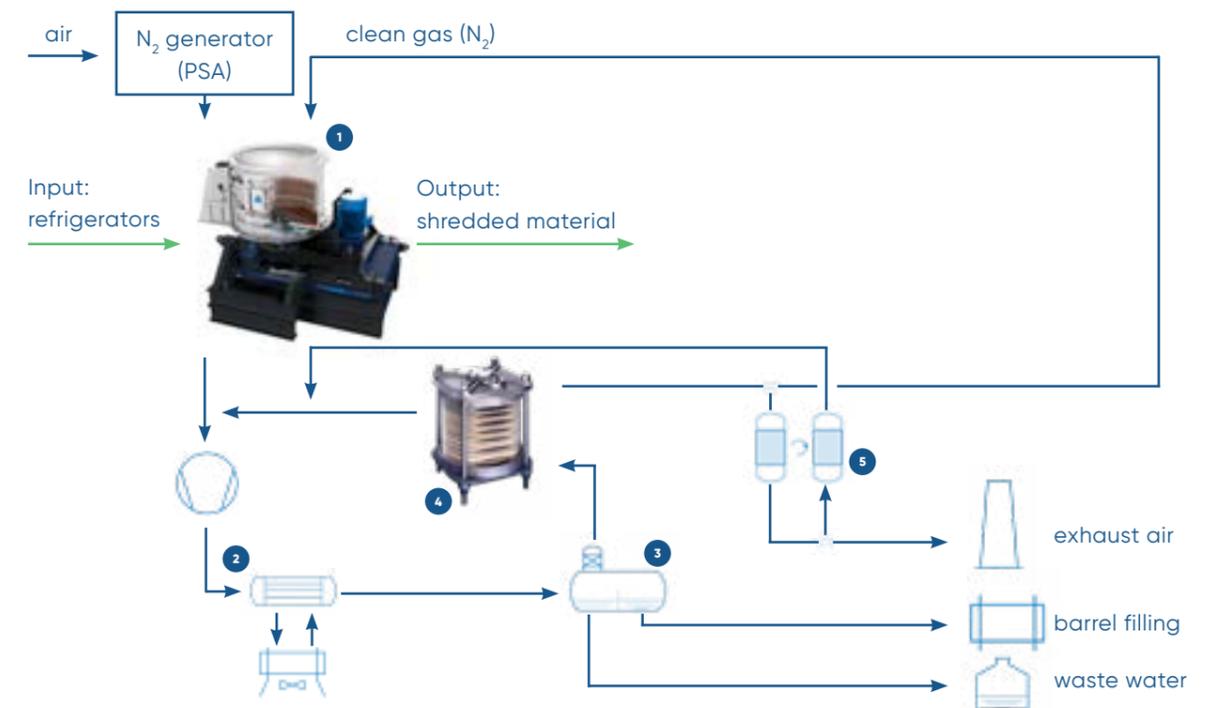
Propellants, such as Pentanes and halogenated hydrocarbons (CFC) are indispensable propellants applied for insulating foams on refrigerators. However, since these propellants are environmentally harmful greenhouse gases, the appliances must be disposed of responsibly and in accordance with environmental regulations. The relevant specifications and guidelines as well as the limit values for released propellant are set out in WEEELABEX.

Exploring the process of the ANDRITZ-BORSIG PMR

During shredding, the propellants are released to the system's gas phase. To maintain a non-hazardous atmosphere, Nitrogen is introduced as an inert gas. The corresponding gas mixture needs to be treated prior to exposure to the atmosphere.

When it is introduced into the PMR process unit, the process gas is directed to an oil-injected screw-type compression system that is operated at a discharge pressure of approx. 12 bar(a). The gas/vapor is routed to the condensation skid and cooled down to 10-15 °C, which liquifies a significant portion of propellant and water. The condensate is fed into a decanter, from where the aqueous phase is routed to a waste water collector tank and the propellant to a barrel-filling station. Residual, non-condensable gas (mainly Nitrogen) / vapor (propellant) portion is fed to the membrane stage. Driven by a partial pressure difference, the propellant is passing the membrane, while the Nitrogen remains on the upper side. This permeated gas is routed to the inlet of gas compressor. Consequently, this recirculation raises

the dew point of propellant for efficient liquification during cooling in main condenser. On the membrane's upstream outlet, pre-cleaned residual exhaust gas can be partially returned to the shredder. Another portion is routed to activated carbon type pressure swing adsorption (PSA) for final purification before venting to the environment. In the PSA unit, one adsorber vessel is in operation for removing residual HC traces, whereas the second installed adsorber is in regeneration under low pressure returning the captured propellant to compressor suction. Both adsorbers are connected to a changeover valve combination, allowing operation / regeneration in a defined time cycle. The cooling is achieved by a free air-cooled system combined with a chiller unit, using a closed loop.



- 1 Fridge shredding with ADuro QZ technology
- 2 Compression and cooling of process gas
- 3 Three phase separation
- 4 Membrane propellant separation
- 5 Final gas treatment with PSA

Benefits of ANDRITZ – BORSIG PMR

The ANDRITZ – BORSIG PMR system presents a comprehensive array of benefits that cater to various industrial needs.

By significantly reducing operational expenditures, it enables businesses to optimize costs effectively. Furthermore, by eliminating the need for liquid Nitrogen, it streamlines processes, reduces dependency on external resources, and increases the availability (> 90%). The system's modular layout allows for flexible installation and accommodating.



Customized membrane package unit | BORSIG

KEY PERFORMANCE INDICATORS

Throughput	up to 150 refrigerators per hour
Propellant recovery	≥ 99.9%
Exhaust gas purity	in compliance with WEELABEX/ EN 50625
Req. electrical power	approx. 120 kW [total]

BENEFITS

- Significant reduction of OPEX and maintenance
- Elimination of liquid Nitrogen utilization
- Modular layout for flexible installation in new and retrofit projects
- Reusable propellant in case of Pentane only treatment

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