



# OIL SHALE PROCESSING JOINT VENTURE IN AUVERE, ESTONIA

**High-capacity plant produces 290,000 metric tons of shale oil annually and utilizes Outotec solid heat carrier technology to extract oil and produce electricity.**

Enefit has operated two Enefit140 production units in Auvere, Estonia for decades. An Enefit280 plant utilizing Enefit technology was added to the shale oil plant complex in 2012, utilizing Outotec solid heat carrier technology. Outotec and Enefit's joint venture, Enefit Outotec Technology, will develop and license a new generation of Enefit technology, utilizing the solid heat carrier process to produce oil from oil shale and other hydrocarbon-bearing materials. The new Enefit280 plant is named for its planned 280-ton oil shale feed capacity.

## CHALLENGES

- Decreasing oil resources worldwide
- Efficient and complete utilization of organic matter
- Strict emissions limits

## SOLUTION

- Combustion of organic material downstream of oil extraction in Outotec Circulating Fluidized Bed
- Retort for separating the solids from gaseous fraction
- Heat recovery in Outotec Fluidized Bed Coolers and Heat Recovery Boiler

## BENEFITS

- Total organic carbon left in the ash reduced to zero
- Excess heat is used for power production
- Emissions limits in line with stringent EU standards

# OUTOTEC SOLID HEAT CARRIER PROCESS

Wet oil shale is fed into a Venturi dryer, where the hot flue gas from the heat recovery boiler evaporates the moisture. Downstream of the dryer, a cyclone separates the dried oil shale from the gas stream. The dried oil shale and solid heat carrier – the ash from the semi-coke combustion process – are fed into a retort. The remaining solids particles in the flue gas are separated using an electrostatic precipitator (ESP) before the cleaned flue gas is released to a stack.

The dried oil shale is heated in the retort until it reaches reaction temperature through direct contact with the heat carrier solids. The organic material in the oil shale decomposes and hydrocarbon gas and oil fumes are released. These gases and fumes are separated from the remaining solids in a dust chamber and a cyclone. The gas is then transferred to a condensation unit for oil and fuel gas production.

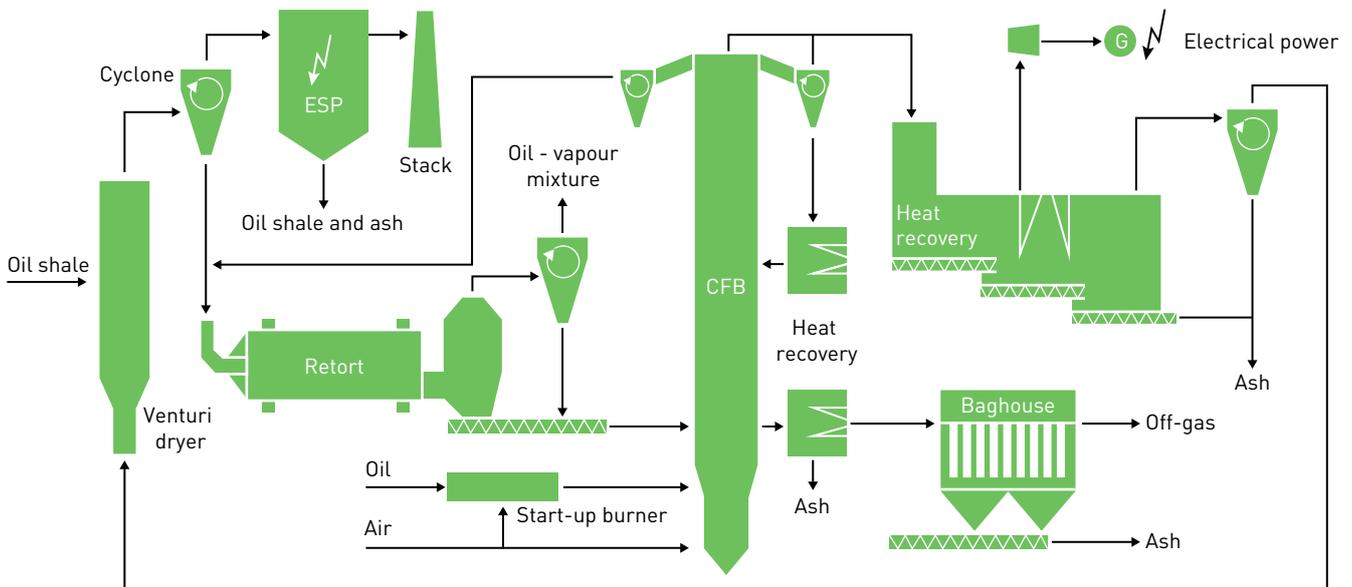
Semi-coke from the dust chamber and cyclone is fed to a circulating fluidized bed. With a low calorific solids feed of 780 tons per hour, at the time of completion it was the largest circulating fluidized bed in the world.

## Project scope

Outotec was the EPC contractor for the heat carrier process and the oil shale material feed preparation (600 t/h) upstream of the process.

## DESIGN DATA

Throughput	
Oil shale	280 t/h
Venturi dryer	
Oil shale moisture input	12%
Oil shale moisture outlet	<0.1%
Retort (thermal decomposition)	
Oil shale input	246 t/h
Flue gas flow outlet	26,500 m <sup>3</sup> /h (STP)
Circulating fluidized bed	
Semi-coke input	780 t/h
Heat recovery boiler	
Steam temperature	450°C
Steam pressure	41 bar(g)
Emissions (STP)	
Dust	<30 mg/m <sup>3</sup>
NO <sub>x</sub>	<200 mg/m <sup>3</sup>
SO <sub>2</sub>	<50 mg/m <sup>3</sup>
Efficiency (produced from 1 ton of dried oil shale)	
Oil	0.15 t
Gas (STP)	39.4 m <sup>3</sup>
Electric power (net)	90 kW
Total energy efficiency	81%



Enfit280 Oil Shale Plant

Outotec provides leading technologies and services for the sustainable use of Earth's natural resources. As the global leader in minerals and metals processing technology, we have developed many breakthrough technologies over the decades for our customers in metals and mining industry. We also provide innovative solutions for industrial water treatment, the utilization of alternative energy sources and the chemical industry. Outotec shares are listed on NASDAQ OMX Helsinki. [www.outotec.com](http://www.outotec.com)