



# Continuous environmental improvements at ALUM refinery

# ALUM STRATEGY FOR ENVIRONMENTAL PROTECTION

ALUM S.A. is part of a vertically aluminium integrated company and is located in Tulcea, Romania. The main production is calcined alumina for smelter production.

The refinery capacity is 600,000 tons of calcined alumina per year. Since 2005 ALUM SA is part of VIMETCO Group.

Certifications - ISO 9001/2015, ISO 14001/2015, OHSAS 18001/2008, under certification ISO 50001/2011.

## Main environmental directions developed by VIMETCO Alum

### Red mud (Primary raw material residue)

- Red mud disposal and storage site improvements;
- New red mud disposal and storage technology to comply with the EU directives recommendation regarding the environmental protection;
- Continuous research with prestigious research institutes for a further utilization of red mud;
- Studies and research for red mud moisture decreasing from actual 48% at 20% mass percentage;

### Progressive reduction of CO<sub>2</sub> emissions

- New natural gas burning systems at power house;
- New process control systems;
- Increase process thermal energy recovery degree;

### Air emissions reduction

- Replacement of the electrofilters with new bag filters;
- Installation recirculation systems for burnt gasses;

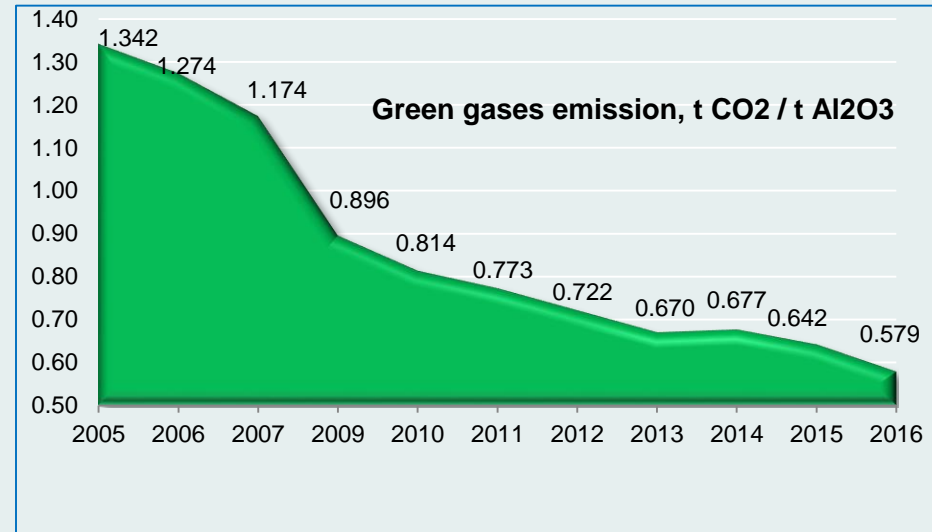
### Progressive reduction of industrial water consumption

- Installation and commissioning 3 new forced cooling towers;
- Supplementary heat exchangers between process fluids commissioning;

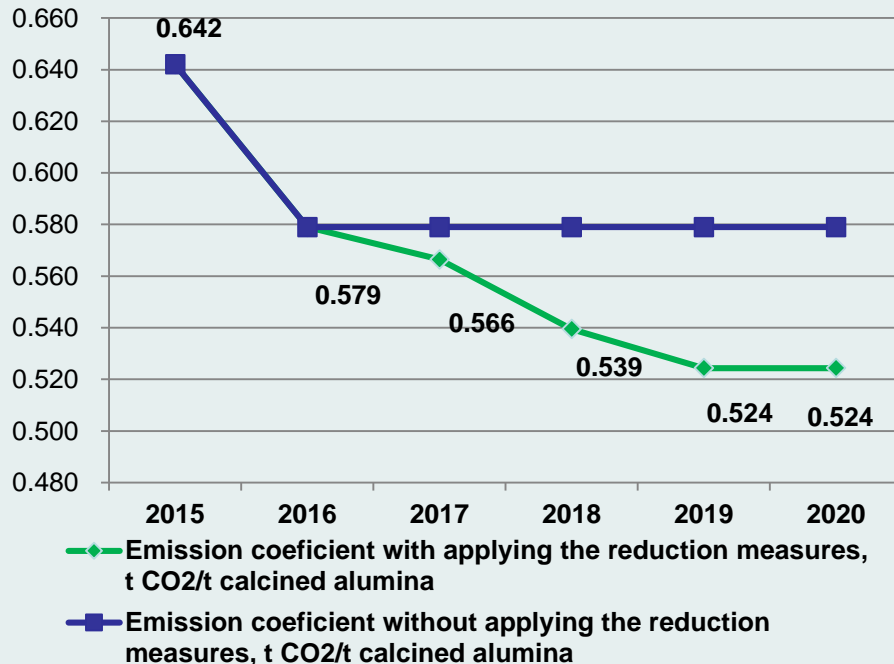
# Fuel consumption and CO2 emissions

For Alum, reducing both fuel consumption and CO<sub>2</sub> emissions is a constant concern.

Thus in the period 2005-2016, due to performed investment works and changes of operating parameters, CO<sub>2</sub> emissions decreased with 57% compared to 2005



Evolution of emission factor, t CO<sub>2</sub>/t calcined alumina



The action plan for further CO<sub>2</sub> emission reduction includes:

- Modernization of two energetical boilers by installing high performance natural gas burners with low NO<sub>x</sub> emissions
- Install new plate heat exchangers to recover the thermal energy from plant liquors
- Replace the obsolete thermal insulations in some plant areas

By applying the measures included in the program we estimate to reduce until 2020 a number of 73,100 CO<sub>2</sub> tons compared with present values.

# ALUM - Main Results

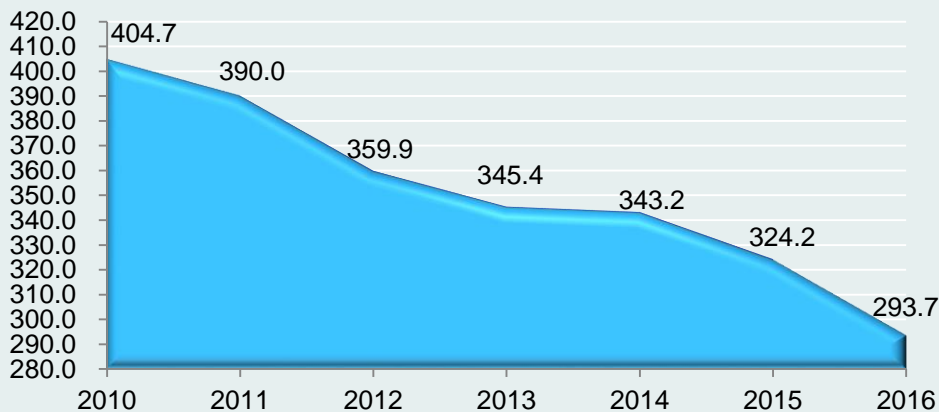
**Specific thermal energy  
Power consumption (GJ/t alumina)**



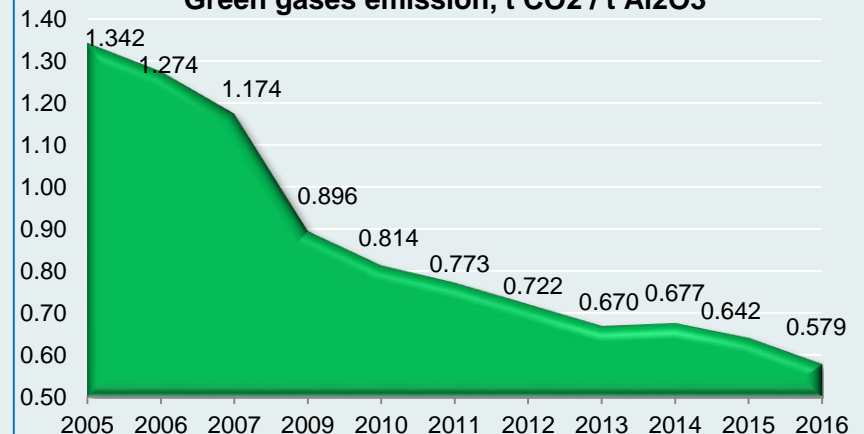
The energy consumption and GHG emissions decreased year by year thanks to the technical improvements implemented:

- The specific thermal energy consumption decreased by roughly 44 % in 11 years
- The specific natural gas consumption decreased by 27.5 % in the last 6 years
- Reduced GHG emissions by roughly 57% in 11 years

**Total Specific natural gas consumption, m3/t Al2O3**



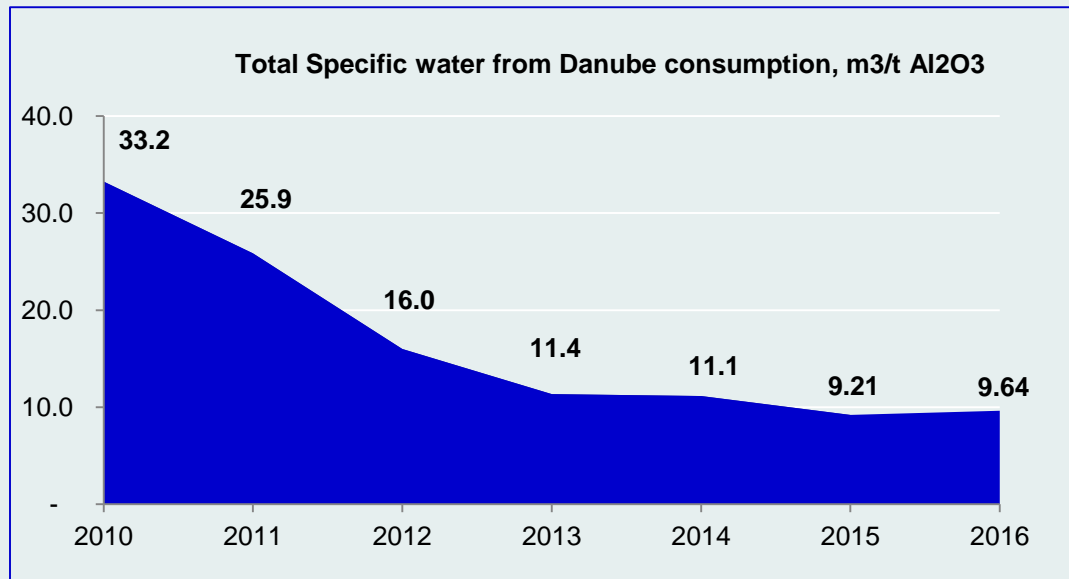
**Green gases emission, t CO<sub>2</sub> / t Al<sub>2</sub>O<sub>3</sub>**



# Water consumption

Starting with 2011 an intensive program decrease the water consumption into the refinery was applied. Between 2011 and 2016 there were built and put in operation 3 new forced cooling towers.

**We achieved a total reduction of water consumption by 71% from the values before 2010.**



Forced cooling tower



Water pumping station



# Air emissions at calcination

Bag filters

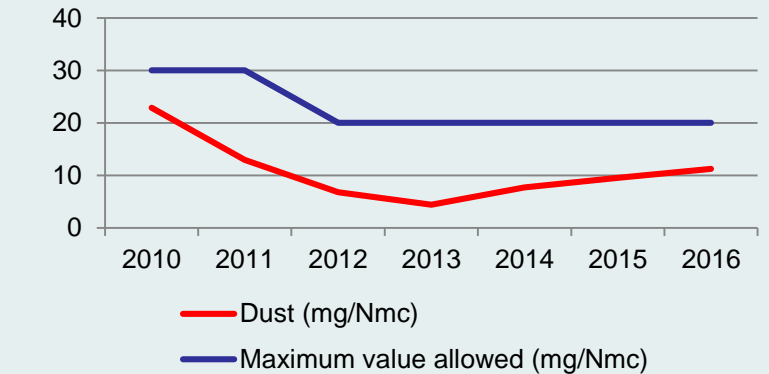
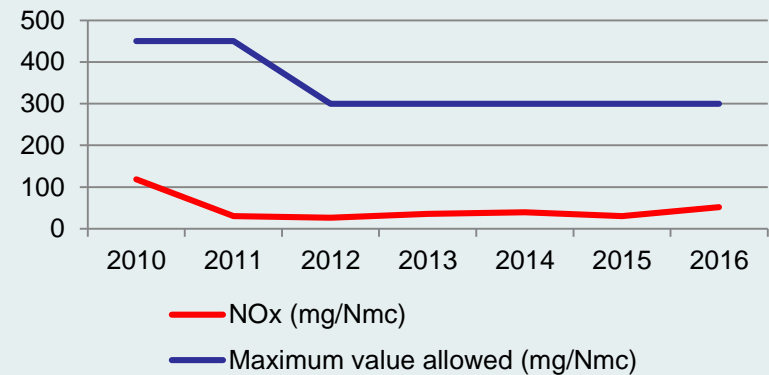
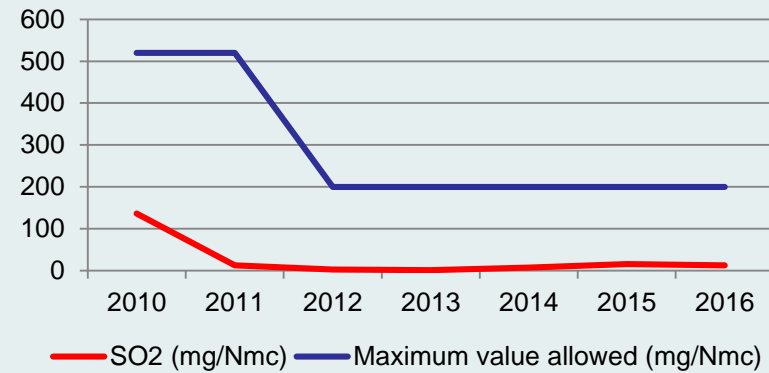


Vertical kiln



Alum has changed the burned gases filtration technology by replacing the old electro precipitators units with new bag filters according to the BAT recommendations.

The dust emissions were reduced from initial values of 100 mg/Nm<sup>3</sup> to actual 13 mg/Nm<sup>3</sup> in the burned gases.



# Bauxite residue site disposal description (1)

The red mud disposal site is located at 5 km distance from the refinery.  
The red mud storage technology was changed starting 2009 and this includes the switching from red mud sludge lagoon impoundment to paste thickening and dry stacking.

The main improvements brought in by the new implemented technology for red mud disposal concern the following changes:

- ✓ paste thickener
- ✓ dry stacking
- ✓ consolidation of the dams
- ✓ full fencing and complete surveillance
- ✓ site partial closure facing the main dam and planting of 35,000 trees
- ✓ pluvial water collecting and detouring channel for preventing site over-flooding
- ✓ water-sprinkling systems to keep the dry material surface moistened
- ✓ pumping systems for the red mud adduction and for returning the clarified liquor to refinery in order to be used in the technological process
- ✓ a waste water monitoring system consisting in drilling boreholes and piezo metric landmarks.

All the changes were done in cooperation with specialists from Hatch Ltd Australia, Technical University of Civil Engineering Bucharest and Iprolam SA Bucharest.

# Bauxite residue site disposal description (2)

The entire work complies with the EU directives recommendation regarding the environmental protection:

- the environmental risk has been considerably reduced compared to previous technology for red mud disposal;
- the environmental authorities are performing periodical inspections on site in order to verify the compliance with the environmental legislation;
- red mud pond dams:
  - ❑ are periodically verified by authorized experts and are approved for safe operation by National Dams Committee;
  - ❑ all construction projects are elaborated in collaboration with Technical University of Civil Engineering Bucharest, endorsed by authorized experts and approved by National Dam Committee.



**P1. Frontal dam, illuminated fencing and pumping station**



**P2. The last part of the collecting pluvial water channel – designed to reduce speed of the rain water**



# Bauxite residue site disposal description (3)



**P3. Dyke and pluvial water detouring channel**



**P4. Sprinklers system for spraying the mud surface**



**P5. Converted area ~ 4.5 hectares**



**P6. Paste thickener & red mud moistening sprinklers**

# Red mud site disposal description

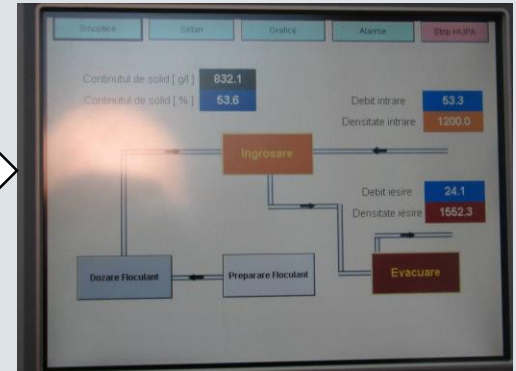


**P7. Red mud thickener**

**Pumping system**



**Continuous monitoring**



**Automatization systems**



# Solutions for using the red mud in industrial applications (1)

During the recent years were performed:

- ❑ **several monitoring services** conducted by some prestigious research institutes in Romania, respectively ICIM Bucharest (Research Institute of the Ministry of Environment), ECOIND Bucharest, IMNR Bucharest, IPROCHIM SA Bucharest and others, through researches and laboratory tests. All these supplementary activities led to the conclusion that **the environmental impact of the red mud disposal site over surrounding agricultural area is not significant.**
- ❑ **some projects in ALUM's laboratory** and in cooperation with other Romanian research institutes to find technologies to convert red mud into a commercial product:
  - preparation of metallurgical multi-flux intended to be used in pig iron production or in other applications;
  - the use of raw or processed red mud as alkaline adjuvant for acidic soils or as a major component in artificial soils used for remediation and landscape architecture;

The results of some projects were communicated in several international conferences

- **Redmud Conference – Bauxite Residue Valorization and Best Practices – UK Leuven, October 2015**
- **The XXII International Congress and Exhibition on Non Ferrous Metals & Minerals, 2016 Krasnoyarsk Russia**, where ALUM has been awarded a Honorary Diploma in the “Best Report” nomination for its presentation “Bauxite residue safety disposal and possibilities to further utilization”;

# Solutions for using the red mud in industrial applications (2)

Alum joined to the Innovation Hub founded by the members of the European Aluminium.

In this respect the consortium **RemovAL** formed by:

- European Aluminium members (ALRO, AoG, Rio Tinto Alcan, ALCOA, RUSAL, HYDRO),
- Alumina companies (Alum Tulcea, Alumina Espaniola, Aughinish Alumina, Aluminium Pechiney),
- Prestigious European Universities (National Technical University of Athens - Greece, Norges Teknik Naturvitenskapelige Universitet - Norway, Katholieke Universiteit Leuven – Belgium, University of Limerick – Ireland, Rheinisch Westfaelische Technische Hochschule Aachen - Germany) and
- European research institutes.

applied to a funding program for innovation and research under **Horizon 2020**, in order to find viable economical solutions for developing technologies to use the red mud and other industrial wastes to produce valuable goods or materials to be used in other industries.

The studies and pilot tests will be performed over a period of 4 years by the Universities and research Institutes for each particular type of red mud produced by the alumina refineries which are part of the consortium.



# Thank you !

VIMETCO

ALUM

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