MONOLITHOS AT A GLANCE

LOCATIONS: HEAD OFFICE: Vrilissou 83, 11476 Athens
PRODUCTION: Anonymou 5 and Anonymou 7, 10442 Athens
DISTRIBUTION CENTER NORTH GREECE: Thessaloniki

LICENSING: PRODUCTION OF EMISSION CONTROL DEVICES (CATS, DPFS)
COLLECTION, TRANSFER, TEMPORARY STORAGE
PRE-PROCESSING AND ASSAYING OF SPENT CATALYSTS

CLIENT PORTFOLIO
1025 Greek Professional Automotive Workshops
Clients for aftermarket products

1335 Greek Suppliers of spent automotive catalysts for recycling

ECONOMICAL FIGURES
All domestic and foreign suppliers are being paid in advance (zero open accounts to suppliers)
Zero Bank Loans

Exports to Europe: 35.7% of Total Revenue
COMMERCIAL ACTIVITIES

Automotive
Catalytic Converters & Diesel
Particulate Filters (DPFs) Manufacturing

Recycling & Assaying of Platinum Group Metals
COMMERCIAL ACTIVITIES

MONOLITHOS

Diesel Particulate Filters (DPFs) & Selective Catalytic Reduction Systems (SCRs) Regeneration

Marine & Stationary Catalytic Applications

Heavy Duty Applications
MONOLITHOS circular economy scheme aims in using only recycled critical raw materials (namely PGMs, rare earths as well as cobalt, tungsten and vanadium) for the total new catalysts production by implementing low critical raw materials nanocatalysts and cost-effective recycling technologies.
LABORATORY CAPABILITIES

MONOLITHOS

**MILLING**
2 laboratory mills, 1 ball/chain mill with capacity of 20kg and 1 large ball mill with capacity of 1tn.
Spent automotive catalysts and filters are collected and milled to obtain the appropriate particle size for the PGM recovery process.

**PARTICLE SIZE ANALYSIS**
Sieve shaker for grinding determination and sieve sequence with 125μm, 250μm, 350μm, 1mm and 2mm opening size sieves.

**SCALE-UP PROCESS**
8 reactors
(1lt, 2lt, 3lt, 5lt, 10lt, 15lt)
- Critical Raw Materials (PGMs, Co, V, W and Rare Earths) recovery from spent catalysts.
- Synthesis of Polymetallic Nano-Catalytic Powders.

**AGING FURNACES**
With 3lt and 70lt capacity
Furnaces are used in synthesis and aging of the catalysts processes.

**LABORATORY SYNTHETIC GAS BENCH**
The light off and the activity of fresh and aged catalyst is determined in laboratory scale.

**XRF ANALYSIS**
The PGM content of new and spent catalytic powders is determined. The machine has been calibrated in the area of 1-5000ppm for Pt, Pd and Rh.

**OPTICAL MICROSCOPY**
Catalytic nanoparticles distribution on the substrate is examined with optical microscopy.

**PORTABLE FLUE GAS ANALYSER**
Opacity and toxic gases (CO, HC, NOx) are determined in real driving conditions.
R&I Staff

Management

- Iakovos Yakoumis, Chemical Engineer (MSc), CEO and Founder
- Ekaterini Polyzou, Chemical Engineer (MSc), COO and Founder
- Anthi-Maria Sofianou, Economist, CPO and Founder
- Anastasia-Maria Moschovi, Material Scientist (Phd), CTO
- Konstantinos Sakkas, Metallurgical Engineer (Phd), Head of Business Development

Researchers

- Panagiota-Argyro Doika, Chemical Engineer (MSc), Catalyst Efficiency and Jr. Project Manager
- Marianna Panou, Material Scientist (MSc), PGM recycling and Laboratory Supervisor
- Ioannis Stamatopoulos, Chemist (Phd), Catalyst Synthesis
- Ioanna-Ydili Betsi-Argyropoulou, Environmental Engineer (MSc), Membrane and Diesel Applications
- Papagianni Sotiria, Metallurgical Engineer (MSc), PGM recycling
- Spathariotis Stylianos, Metallurgical Engineer (PhD), Jr. Business Developer (starting 1/3/2020)
ON GOING EUROPEAN R&I PROJECTS

TOXIC EMISSION CONTROL FOR THE AUTOMOTIVE SECTOR

Key target of the PROMETHEUS project is to demonstrate in large scale the substitution up to 67% of the PGMs used in automotive catalysts.

EURO6CAT
The EURO6CAT project will introduce a disruptive innovation in automotive emission control, by designing, optimizing and testing under real conditions hybrid catalytic after-treatment systems substituting cast iron alloys and expensive and critical Platinum Group Metals, by lighter and of improved thermal resistance cast alloys and copper nano-particles based catalysts.

TOXIC EMISSION CONTROL FOR HEAVY DUTY APPLICATIONS

The project will implement the use of innovative Catalyst Based Emission Control System on heavy duty vehicles.

The project aims to stimulate the emergence of territorial ecosystems for PGMs recycling and substitution in automotive catalysts, based on a new technology that substitutes PGMs with copper nanoparticles.

INDUSTRIAL CATALYSTS
SAFE - VULCA
An upscaling project SAFE-VULCA aimed at Safer reduction of ZnO amount in rubber vulcanization process run together with Pirelli Tyre S.p.A.

RECYCLING OF CATALYSTS


HORIZON2020: First of a kind commercial Compact system for the efficient Recovery Of Cobalt. Designed with novel Integrated LEading technologies

CO₂ EMISSION CONTROL

Carbon Dioxide Absorbing Materials Project RISE
The objective is to find an inexpensive, effective and robust solution for significant CO₂ reduction from industries and civil transport.

TRAINING IN THE FILED OF CRM'S AND CIRCULAR ECONOMY

The project BREAKit proposes a training path to help researchers and other technical professionals in the transition from a technical and specialised profile to a T-shaped profile.

BRIEFCASE
Learning the Uses of Minerals Through Non-Conventional Teaching Tools
PROJECT AGREEMENT NO <18115>
The Network is being funded under EU COST Action A15102.

http://www.crm-extreme.eu/

The Network is being funded under the EU COST Action Initiative TD 1408.

http://www.intrepid-cost.eu/

The Network is being funded under the EU COST Action Initiative TD 1407.

http://www.costnotice.net/
R & I COLLABORATORS

MONOLITHOS

tecnalia  vito  JM
Johnson Matthey

ICCRAM  KU LEUVEN  SINTEF

FORD OTOSAN  CRF  BOLIDEN

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

Env-Aqua Solutions  uniss  UNIVERSITÀ POLITECNICA DELLE MARCHE

Universität der Studi di Sassari  TU Wien  Vienna University of Technology
PATENTS

• Copper based catalysts for engine exhaust gas stream treatment (EP19386014).
• Method, device and process for the treatment of engine flue gases with high oxygen excess (EP19386007).
• Method, device and process for the abatement of SO2 emissions in internal combustion engines (pending).

PUBLICATIONS

• A. Gutierrez et al., 2019, The Journal of Physical Chemistry “Insights on Carbon Nanotubes and Fullerenes in Molten Alkali Carbonates”, DOI: 10.1021/acs.jpcc.9b00855
• A. Gutiérrez et al., 2018, Langmuir “Theoretical Study on Molten Alkali Carbonate Interfaces” DOI: 10.1021/acs.langmuir.8b02907
• I. Yakoumis et al., 2018, “Real life experimental determination of platinum group metals content in automotive catalytic converters”, IOP Conference Series: Material Science and Engineering, DOI: 10.1088/1757-899X/329/1/012009
• I. Yakoumis et al., 2016, Journal of Membrane Science, “Tubular C/Cu decorated γ-alumina membranes for NO abatement”, DOI: 10.1016/j.memsci.2016.05.047
• G. Kolliopoulos et al., 2014, OALib Journal “Behaviour of platinum group metals during their pyrometallurgical recovery from spent automotive catalysts”, DOI: 10.4236
DISSEMINATION

KEY-NOTE CONFERENCE PRESENTATION


INVITED LECTURES

• 2018, 18th International Conference on Environment and Electrical Engineering, Palermo, Italy “An integrated circular economy model for decoupling Europe from Platinum Group Metals supply risk in the automotive sector”.

• Lisbon Training Scholl (6-7/2/2017), “Financing innovative SMEs in the area of critical raw materials”.


• 21st International Workshop of TACEC Programe, 2014, “How to treat catalyst to recover precious metals and rare earths”.

• University of Padova, 2014, “Critical Materials and Automotive Catalytic Converters: From substitution to recycling”.

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