

18

INTERNATIONAL
CONFERENCE ON
ENVIRONMENTAL
SCIENCE &
TECHNOLOGY



CEST 2023

cest.gnest.org

GREEN & CIRCULAR HYBRID EVENT

Wed 30 Aug - Sat 2 Sep 2023

athens / greece
2023

532

EPS waste management from coastal cleaning actions: identification of contamination sources, collection, treatment, and re- use in cement-based materials

Alexopoulos N.^{1*}, Filippidis A.², Lekkas D.³, Metaxa Z.⁴, Prokopiou V.⁴

1 Research Unit of Advanced 4 Materials, Department of Financial Engineering, School of Engineering, University of the Aegean, 41, Kountouriotou str, 82132, Chios, Greece

2 «OZON» Non-Governmental Organization, Loutra Oreas Elenis, 20100, Corinth, Greece

3 Waste Management Laboratory, Department of Environmental Studies, University of the Aegean, Mytilene, 81100, Greece

4 Department of Chemistry, International Hellenic University, St. Luke, Kavala, 65404, Greece,

EPS: Waste Nightmare

Non-biodegradable material

100+ years to decompose

Lot of space in dump

Difficult Management

Contains toxic substances

Transport to environment

EPS beads properties

Tiny Size - Durable

Main Sources of EPS Pollution

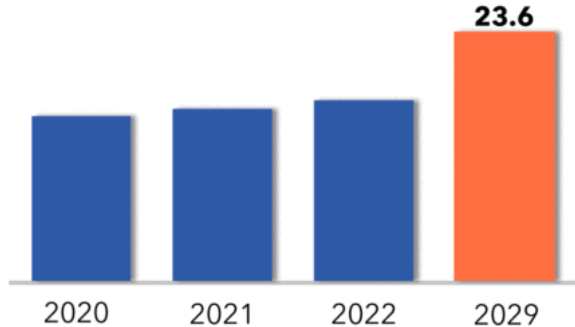


Production Forecast

Global EPS production forecast

Increase production through 2029

Poorly managed waste



Global Plastic Production

2017

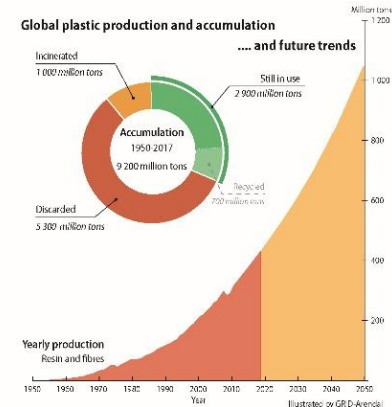
2,9B Tons

2050

34B Tons

Reduce production
of virgin plastics

Increase recycled
plastic waste



Mediterranean Gulf Pollution

>24M Tons Plastic Waste per year

6th Place in marine litter worldwide

0.57 M tons of plastic enter per year

**Atlantic Ocean inflow into Gulf
Not outflow from Gulf**

**Large accumulation of plastic
on the southeast side**

Impact on blue economy - Tourism

Suspended plastics of global origin

33,800 plastic bottles per minute



Arcangeli et al. Marine Pollution Bulletin 129(2) (2020), 545–554

Zambianchi et al. Frontiers in Environmental Science 5 (2017)

Danovaro et al. Marine Policy 112 (2020), 103781

EPS foams have a wide yet uneven geographical distribution

EPS litter are transported long distances by currents and wind

Trapped by rocks and coastal vegetation creating aggregations

The cost of collection, handling and transport is a critical requirement for EPS waste recovery



EPS Burden Indicators

 **Low**

 **Med**

 **High**

Photo investigation EPS Waste

Expose Hotspot EPS Waste

Help in collection planning

Performing efficient operations



Photographic assessment methods

Identification of waste sources

Quantification of waste load

Assessment of relief and flora

Optimized collection plan design

Determination of weight per object

Visible / non-visible accumulation points

EPS waste coast collection

Laborious and costly process

Large range of object volume

Difficult the process reduction

Inaccessible accumulation points

Lots of marine activity materials

Additional coastal pollution

Waste management in the field

Time-consuming procedure

Requires tools for reduction

Releases EPS beads



Transportation from the coast

Use boat and/or pick up truck
for waste transportation

Waste packaging design



Waste management in the land

Safe decontamination area

Assessment of material quality

EPS waste cleaning



Cost estimate - Process Improvement

Stages of the collection process

Detection and recording

EPS waste collection

EPS waste transportation

EPS waste decontamination

Improvement proposals

Use of new technologies
(e.g., Drones)

Prioritization of pollution

Construction of special boat

Smart storage creation
for direct processing

Light weight Concrete (LWC)

LWC is a special Concrete which weights lighter than conversional concrete

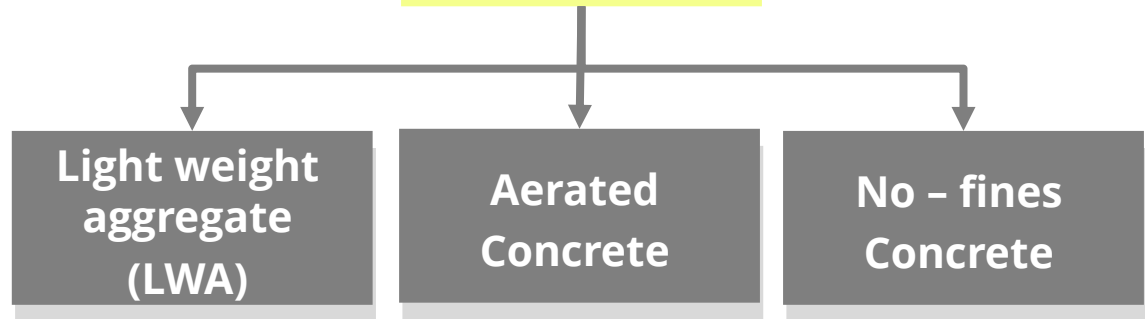
LWC Density

$1440\text{kg/m}^3 - 1840\text{kg/m}^3$

Concrete Density

$2200\text{kg/m}^3 - 2600\text{kg/m}^3$

Types LWC



Light weight Concrete EPS

Produced by partially replacing the cement aggregates with EPS granules of different sizes

Advantages

Material weight reduction

Improve thermal insulation

Improve acoustic insulation

Reduction aggregate production

Mining

Processing

Transportation

Taxes

Civil engineering challenges

Reduction of construction weight

Minimizing cost

Minimizing carbon footprint

Integration of LWA aggregates in LWC

Partial or complete
replacement

Natural
pumice, biopolymers

Issue

High-water
requirement

Artificial
EPS -XPS

Solve

Modified / unmodified
EPS

Processing of EPS granules

Mechanical

Chemical

Physical

Grinding - sieving

Organic solvents

Heat Treatment

EPS Concrete Applications



Cladding Panel



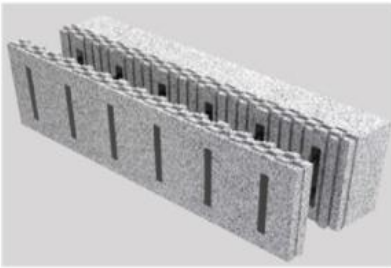
Curtain wall



Composite floor



**Structural
insulated panel**



Concrete blocks



Subbase materials



Road Barrier



Floating Structure

Conclusions

Recovering EPS from the coast is a laborious and costly exercise

Investigating the collection process can be made sustainable and bring real environmental benefits

The use of EPS waste from the coast to produce innovative cement-based products seems sustainable

The study on the optimal treatment of EPS waste is probably the solution to produce cement-based products

18

INTERNATIONAL
CONFERENCE ON
ENVIRONMENTAL
SCIENCE &
TECHNOLOGY



CEST 2023

cest.gnest.org

GREEN & CIRCULAR HYBRID EVENT

Wed 30 Aug - Sat 2 Sep 2023

athens / greece
2023

Thank you for your attention!

Alexopoulos Nikolaos

nalexop@aegean.gr