In search of marine sand – benefits of an European index

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Content

- Importance of sea bed sediment maps and start of data exchange
- Applications of marine sand and gravel
- How much marine sand Europe needs annualy?
- Methods for exploration of the resources
- Benefits of the European indexes
- Sources of marine sand and gravel
 - Mechanisms of supply
 - Sea bed dynamics

Sea bed sediment map of M. Delesse, 1872 Based on hydrographic publications



M. Delesse, 1872, in: Lithology Du Fond des Mers.



Sea bed sediment map of the British fisheries researcher O.T. Olsen,

1883

Based on data of measurements with a leadline ("Soundings") and bottom trawls

O.T. Olsen, 1883, in: Piscatorial Atlas of the North Sea, English and George's Channels.

Sea bed sediment map of J. Tesch, 1911



Based on map of O.T. Olsen, data from fishermen, the German Navy vessel Drache 1884 and the German research vessel Poseidon, 1902-1905

Sea bed sediment map southern North Sea Jarke (1955) Based on all available information and data of 3000 sea bed samples



J. Jarke, 1956, Deutsches Hydrografisches Zeitschrift, 1956

EEZ North Sea 1968 Start of marine investigation programmes per country



Applications of marine sand and gravel

- Coastal extensions and islands
- Landfill
- Beach nourishment
- Burial of pipelines
- Industrial use for concrete and mortar sand







Extraction of marine sand: c. 93.5 million m³ (ICES 2012)

2011	Beach	<u>n nourishment</u>	Industrial	Infill	Total
Belgium		6 99 045	2 778 298		3 477 343
Bulgaria	ND				
Denmark		2 600 000	2 700 000		7 500 000
Estonia (2010)				c. 200 000	c. 200 000
Finland	ND				
France (2010)		ND	2 595 000	ND	2 595 000
Germany (Nor	th Sea	1 000 072	1 555 508		2 556 570
+ Baltic Sea)		1 000 972	1 333 396		2 330 370
Greece	ND				
Ireland	ND				
Iceland	ND				
Italy	ND				
Latvia	ND				
Lithuania		119 000			119 000
Netherlands		37 293 360	2 896 273	22 574 299	62 763 932
Poland (2010)		970 923			970 923
Portugal + Azo	ores	600 000	126 381		726 381
Spain (2010)		200 000			200 000
Sweden		95 562			95 562
Turkey			c. 3 300 000		3 300,000
UK		99 585	11 753 015		11 852 600

Example of standards used in The Netherlands

Beach nourishment:

No specific standard. Grain size depending on the natural grain size of the beach

Infill sand:

No specific standard. $D50 \pm 220$ micron





sand

Mortar

sand

Methods for detecting extractable sand resources

Seismic methods



Sea bed sampling equipment







Boxcorer Undisturbed sample 0 - 50 cm

Vibrocorer Undisturbed Sample 0 - 6 m





Disturbed sample Van Veen grab 0 - 20 cm

Side scan sonar Ground truthing with superficial samples



Single channel seismic record Correlation with vibrocores



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Single channel seismic record



Record with outcrops of basement in a sand extraction area. Correlation with lithological information of vibrocores



www.eu-seased.net

EU-SEASED Seabed samples from the Ocean basins and European Continental Waters

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Usefull data for sand search on-line available:



- Geological data: point & gridded
- Grab samples
- Bathymetry: tracking & gridded + swath
- Borehole: images
- Seismics: digital data & scanned images & navigation
- Side scan sonar images
- Maps: data products

Some examples of use of available information for sand search

Sea bed sediment information



British Geological Survey

Sea bed sediment map of UK, German and Dutch sectors

GeoZentrum Hannover





Geological Survey of The Netherlands

Folk classification



The above classification is based on that of R.L.Folk, 1954, J. Geol., 62 pp344-359.

Detailed Sea bed sediment information Dutch sector





Wentworth classification

φ scale	size range	Wentworth nam
-8 to -∞	256-∞ mm	boulder
-6 to -8	64–256 mm	cobble
-5 to -6	32–64 mm	pebble
-4 to -5	16–32 mm	pebble
-3 to -4	8–16 mm	pebble
-2 to -3	4–8 mm	pebble
-1 to -2	2–4 mm	granule
0 to -1	1–2 mm	very coarse san
1 to 0	0.5–1 mm	coarse sand
2 to 1	0.25–0.5 mm	medium sand
3 to 2	125–250 <i>µ</i> m	fine sand
4 to 3	62.5–125 <i>µ</i> m	very fine sand
5 to 4	31.25–62.5 <i>µ</i> m	silt
∞ to 8	1/∞-3.9 <i>µ</i> m	clay
∞ to 10	1/∞-0.97 <i>µ</i> m	colloid

Folk classification



Geological Survey of The Netherlands

Detailed data German and Danish sectors North Sea



Map showing thickness of sand deposits

M. Zeiler, J. Schulz-Ohlberg & K. Figge BHS, Hamburg



Lithological map Danish sector

Leth et al. 2010) Geus

Morphology of the sea bed based on bathymetric data



Image of sandwaves by multibeam

Mobility of sand waves based on bathymetric data

Automated method to analyze the morphology and dynamics of bed forms.



Mechanisms transporting sand and gravel into the marine environment

Mechanisms of sediment supply in the North Sea



Thickness Quaternary



Eridanos delta



Coastal erosion





Transport by ice (wind) Delta Rhine and Meuse

Growing Eridanos delta



Reached the North Sea c. 12 million years ago. Destroyed by glaciers c. 700.000 years ago

Conclusions:

Benefits of the indexes by:

- Planning of areas for surveying of sand resources
- Preparing preliminary maps of the area by existing data
- Reducing high surveying costs

Recommendation:

• Including grain size and other laboratory analyses

Thank you for your attention