# Dredging Processes

The Cutting of Sand, Clay & Rock Excavating Equipment

Dr.ir. Sape A. Miedema





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## Preface

Lecture notes for the course OE4626 Dredging Processes, for the MSc program Offshore & Dredging Engineering, at the Delft University of Technology.

#### By Dr.ir. Sape A. Miedema, Sunday, January 13, 2013

In dredging, trenching, (deep sea) mining, drilling, tunnel boring and many other applications, sand, clay or rock has to be excavated. The productions (and thus the dimensions) of the excavating equipment range from mm<sup>3</sup>/sec - cm<sup>3</sup>/sec to m<sup>3</sup>/sec. In oil drilling layers with a thickness of a magnitude of 0.2 mm are cut, while in dredging this can be of a magnitude of 0.1 m with cutter suction dredges and meters for clamshells and backhoe's. Some equipment is designed for dry soil, while others operate under water saturated conditions. Installed cutting powers may range up to 10 MW. For both the design, the operation and production estimation of the excavated it is usually transported hydraulically as a slurry over a short (TSHD's) or a long distance (CSD's). Estimating the pressure losses and determining whether or not a bed will occur in the pipeline is of great importance. Fundamental processes of sedimentation, initiation of motion and ersosion of the soil particles determine the transport process and the flow regimes. In TSHD's the soil has to settle during the loading process, where also sedimentation and ersosion will be in equilibrium. In all cases we have to deal with soil and high density soil water mixtures and its fundamental behavior.

This book gives an overview of the equipment involved in cutting processes.

This book will give engineers an impression of the diversity of the excavating equipment and is the  $1^{st}$  of 7 books.

#### Part 1: The Cutting of Sand, Clay & Rock - Excavating Equipment

- Part 2: The Cutting of Sand, Clay & Rock Soil Mechanics
- Part 3: The Cutting of Sand, Clay & Rock Theory
- Part 4: The Loading Process of a Trailing Suction Hopper Dredge.
- Part 5: The Initiation of Motion of Particles..
- Part 6: Hydraulic Transport Theory.
- Part 7: Hydraulic Transport Experiments.

#### Dr.ir. Sape A. Miedema

Dr.ir. Sape A. Miedema Delft University of Technology Delft, the Netherlands Sunday, January 13, 2013

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PDC cutters (Polycrystalline Diamond Composite) are widely used in petroleum/oil field PDC bit, eological PDC exploration bits, gas exploration bits, PCD/PDC coal mining drill bits, ilfield drilling bits, currently, we developed new type of PDC cutters, and the length of the cutter is 32mm, with a round radius of the tungsten carbide substrate of the PDC cutter.



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#### Chapter 13: About the Author.



Dr.ir. Sape A. Miedema (November 8<sup>th</sup> 1955) obtained his M.Sc. degree in Mechanical Engineering with honours at the Delft University of Technology (DUT) in 1983. He obtained his Ph.D. degree on research into the basics of soil cutting in relation with ship motions, in 1987. From 1987 to 1992 he was assistant professor at the chair of Dredging Technology. In 1992 and 1993 he was a member of the management board of Mechanical Engineering & Marine Technology of the DUT. In 1992 he became associate professor at the DUT with the chair of Dredging Technology. From 1996 to 2001 he was appointed educational director of Mechanical Engineering and Marine Technology at the DUT, but still remaining associate professor of Dredging Engineering. In 2005 he was appointed educational director of the MSc program of Offshore Engineering and he is also still associate professor of Dredging Engineering. In 2011 he was also appointed as director of the MSc program Offshore Engineering of the Petrovietnam University.

Dr.ir. S.A. Miedema teaches (or has taught) courses on soil hopper mechanics and soil cutting, sedimentation. mechatronics, applied thermodynamics, drive system design principles, mooring systems and mathematics. His research focuses on the mathematical modeling of dredging systems like, cutter suction dredges, hopper dredges, clamshell dredges, backhoe dredges and trenchers. The fundamental part of the research focuses on the cutting processes of sand, clay and rock, sedimentation processes in Trailing Suction Hopper Dredges and the associated erosion processes. Lately the research focuses on hyperbaric rock cutting in relation with deep sea mining and on hydraulic transport of sand/water slurries.

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