Recent developments on cutter dredgers

Cutter dredgers for the Gulf area

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- Simulation of spud carriage behaviour
New dredgers

Complete range (being) built 2006 – 2010

Total power 4,080 kW, cutter motor 1100 kW
  to
Total power 15,700 kW, cutter motor 3000 kW
4,080 kW CSD (Albzem)

- Length over all, approx.: 65.50 m
- Length over pontoon: 51.10 m
- Width: 14.00 m
- Depth: 4.20 m
- Max. draught, approx.: 3.15 m
- Maximum dredging depth: 16 m
- Diameter suction pipe: 700 mm
- Diameter discharge pipe: 650 mm
- Total installed power: 4080 kW
- Cutter power: 1100 kW
- Power dredge pump drive: 1825 kW
- Main generator sets (2x): 1025 kW
- Auxiliary generator set: 205 kW
16,500 kW CSD (Huta 10)

Length over all, approx. 124.50 m
Length over pontoon 100.10 m
Width 20.30 m
Depth 6.30 m
Average draught. 4.40 m
Max. dredging depth 25 m
Diameter suction pipe 900 mm
Diameter discharge pipe 900 mm
Total installed power 15,700 kW
Cutter motor power 3000 kW
Power submerged dredge pump 1500 kW
Power inboard pumps 2 x 3800 kW
Main generator sets 2 x 3700 kW
4,960 kW CSD (Inai Delima)

- Length over all, approx.: 67.60 m
- Length over pontoon: 51.80 m
- Width: 14.00 m
- Depth: 3.40 m
- Average draught: 2.35 m
- Max. dredging depth: 22 m
- Diameter suction pipe: 750 mm
- Diameter discharge pipe: 750 mm
- Accommodation: 20 persons
- Total installed power: 4960 kW
- Cutter power: 750 kW
- Submerged pump drive: 1641 kW
- Booster pump drive: 1641 kW
Length over all, approx. 100.00 m
Length over pontoon 79.80 m
Width 18.40 m
Depth 4.90 m
Average draught 3.50 m
Max. dredging depth 29 m
Diameter suction pipe 900 mm
Diameter discharge pipe 900 mm
Accommodation 26 persons
Total installed power 13,000 kW
Cutter power 1500 kW
Power submerged
  dredge pump drive 1500 kW
Power inboard pumps 2 x 3700 kW
Main generator sets 3 x 1717 kW
Pumps

- Cutter special pumps with large ball clearance (to match with 6 or 7 bladed cutters)
- High suction performance for shallow dredging
- Same pump type submerged pump and inboard pump(s); single walled submerged, double walled inboard
- Same wear parts submerged pump and inboard pump(s) despite different execution (single/double walled)
Drives

- Identical motors for cutter and submerged pump where possible
Other

- High efficiency dredge pumps / pivoting gearbox
- Pumps and engine room at deck level
- Separate accommodation on dampers
Spud carriage
Simulation of spud carriage behaviour
Simulation model spud carriage

Targets:
- Knowledge of (flexible) spud carriage system behaviour
- Possibility to determine settings of spud carriage characteristics
- Determine safe settings for load limiters

Modelled systems:
- Spud carriage
- Spud
- Wires
- Wire tensioning cylinders
- Load limiter system
- Spud carriage cylinder
CUDAS: CUtter Dredger At Sea

Total dredged volume: 59 [m$^3$]

- production (mean=0.35 [m$^3$/s]=1280 [m$^3$/h])
- volumetimesteps (mean =0.05 [m$^3$/d/s])

Graph showing production and volume over time.
Simulation with conventional spud
Simulation with flexible spud
Buffering characteristics

- $F_{\text{spud}}$ vs. $\delta$
- $F_{\text{max}}$
- $F_{\text{safe}}$

- Conventional
- Spud protection
- Increasingly weak
- Increasingly stiff
- Linear weak

At $3^\circ$, the buffering characteristics change from linear weak to increasingly stiff.
HsTp / workability diagram

89 simulations
Characteristics - spudforce

HsTfp diagram for workability limit: Fspud = 190 kN

- Increasingly weak
- Spud protection
- Conventional
Cutter movement in detail

side view

[Graph showing cutter angle and movement in x[m] and z[m].]
Conclusions - flexibility

Flexibility in spud carriage:
- protects the spud against overload
- improves workability
- will not have a negative effect on output
Validation measurements

- Ras Laffan, Qatar - december 2006
Validation measurements

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- Measurement of approx. 100 variables
- Measurement of wave climate with wave rider
Validation measurements

- Ras Laffan, Qatar - December 2006
- Measurement of approx. 100 variables
- Measurement of wave climate with wave rider
- Maximum wave conditions:
  - Maximum height: 2.7 m
  - Significant height: 1.6 m
- Measured in several operational conditions
Conclusions - simulation tool

Simulation tool provides:

- better understanding of internal forces, motions, system behaviour, etc.
- possibility to evaluate technical executions of flexible spud carriage systems
- possibility to determine settings for flexible spud carriage systems
- evaluation of workability of cutter dredgers
Thank you for your attention