Calculation for the drive unit of central sludge scraper(Φ9*5m)

Basic information

1. The diameter of the scraper is D=9m;

2. Line speed of the outer edge of the scraper: V=2m/min

3. The water depth in the pool is 3.76m

4. The total depth of the pool is 3.09m

5. The maximum depth of the pool center is 5.02m

A. Selection of reducer

Scraper pool diameter Φ9m

It is tentatively estimated that the maximum torque of the mud scraper is 8520N•m

1. The speed of the outer edge of the scraper is 2m/min

2. According to the sample, take the worm gear reducer JWZ250-60 (60-speed ratio)

3. The motor is 4P motor, the speed is 1450

4. Spindle speed of mud scraper: ==0.04245 rpm

5. Overall speed ratio: 1450÷0.04245=34158

Worm Gear Reducer 60

Sprocket ratio = 1.5 (preliminary)

6. The speed ratio of the small reducer is = 379.53

7. The output speed of the small reducer is 1450÷379.53=3.82 rpm

The output torque of the small reducer is = 277.77

The small reducer selects the helical gear reducer R87R57-3.4 rpm-0.37kw The outer edge line speed of the scraper is 1.898m/min

B. Selection of the main shaft of the mud scraper

D=9m, the outer edge line speed of the scraper V=2m/min;

Maximum scraping torque：8520N*m。

1) The main shaft of the mud scraper: seamless pipe is used.

2) Primary selection of seamless pipe Φ219×10

3) Shear stress under the action of torque:

rmax=Mt/Wt

Mt——torque 8520N*m=85200kg*cm。

Wt——torsional section modulus $\pi/32\times D^4$-（$1-\alpha^4$）/(D/2)=$0.2D^3\times$（$1-\alpha^4$）

=$0.2\times21.9^3\times$[1-（$19.9/21.9$）^{4}]

=2100.69×（1-0.6815）

=669.07cm^3

rmax=Mt/Wt=85200kg*cm/669.07cm^3=12.73kg/cm^2 ＜1280kg/cm^2 safe

4）maximum twist angle Φ=MtL/GIt×180/π（°）或 Φ=Mt×100/GIt×180/π（°）

Mt =85200kg*cm

G =E/2（1+μ）=2.1×10^6/2（1+0.3）=807692 （Poisson's ratioμ=0.3）

It =$\pi/32\times D^{4\times}$（$1-\alpha^4$）=0.1 D^4（$1-\alpha^4$）

=$0.1\times21.9^4\times$[1-（$19.9/21.9$）^{4}]

=23002.6×（1-0.6815）

=7326.3

Φ=Mt×100/807692×7326.3×（180/π）

=0.001439×（180/π）

=0.082°/米 ＜0.25-0.5°acceptable