歐盟離心泵效率標準

簡煥然

煜然有限公司　　總經理

0. 基本計算公式

泵浦效率 $\eta_p\% = \frac{P_{hy}}{P_2} \times 100\%$

泵浦總效率 $\eta\% = \frac{P_{hy}}{P_1} \times 100\%$

泵浦總效率 $\eta\% = \eta_p\% \times \eta_m\%$

$EUI = \frac{P_1}{P_{hy}} = \frac{1}{\eta\%} = \frac{1}{\eta_p\% \times \eta_m\%}$

P_{hy}：輸出流功率(kW)
P_2：輸入軸功率(kW)
P_1：輸入有效耗電功率(kW)
η_m：馬達效率(%)
EUI：耗電比(kW/kW)
hy：Hyraulic(水力)的縮寫

輸出流功率 $P_{hy} = \rho \times g \times Q \times H \times 10^{-3}$

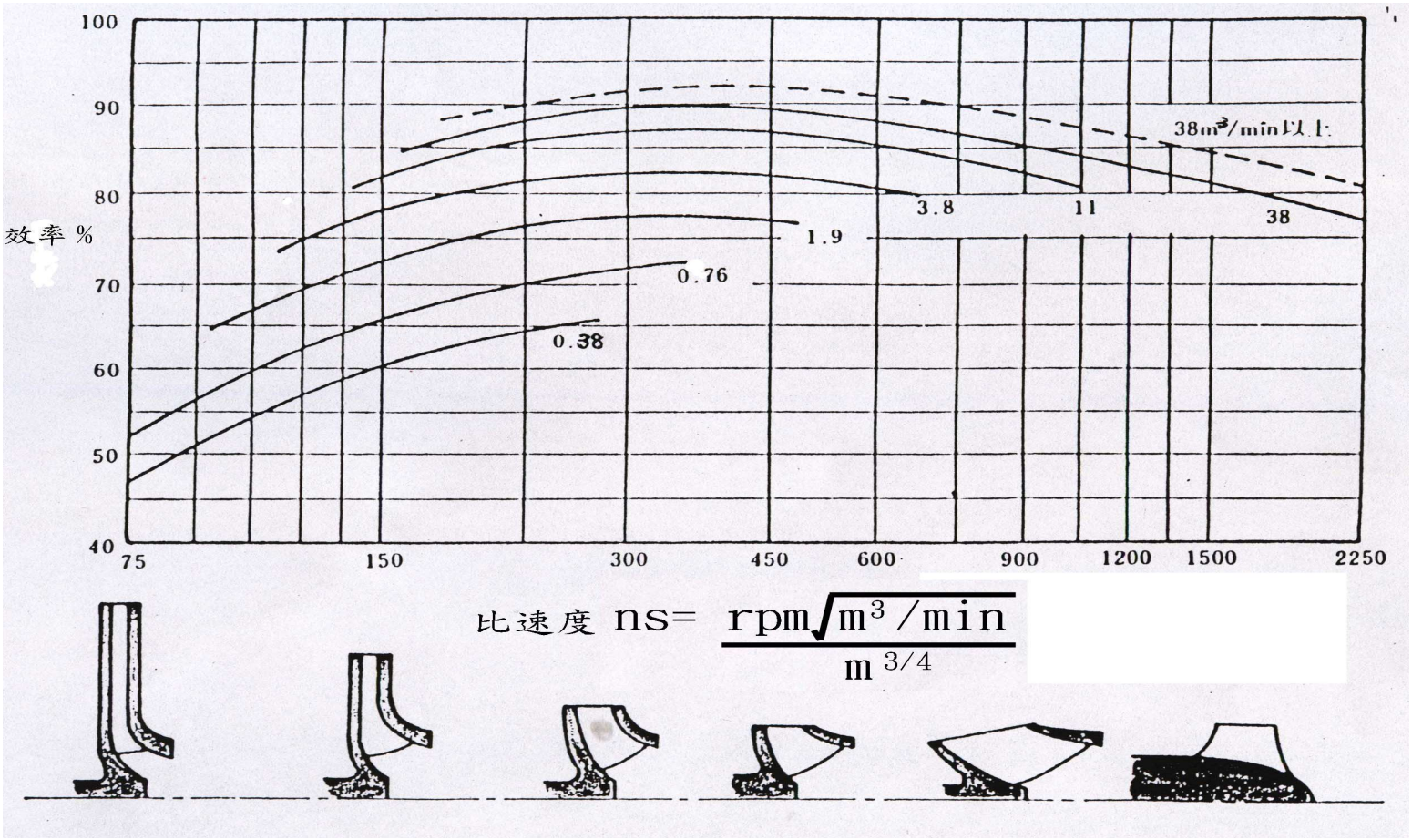
比轉速n_s歐盟 $n_s = \frac{rpm \times Q^{0.5}}{H^{0.75}} \times 100\%$

比轉速n_s中國 $n_s = 3.65 \times \frac{rpm \times Q^{0.5}}{H^{0.75}} \times 100\%$

ρ：密度(kg/m^3)
g：重力加速度9.81(m/s^2)
Q：流量(m^3/s)
H：揚程(m)

1. Stepanoff 泵浦效率標準

等比例放大，Ns不變，流量增大效率也提高
等比例縮小，Ns不變，流量減少效率也降低
評比泵浦額定點效能最佳工具。



2. 歐盟有關泵浦效率推動

http://www.ecomotors.org/documents.htm#2

1. European guide to pump efficiency for single stage centrifugal pumps May 2003
2. Documentation on the meetings of the Consultation Forum
   http://ec.europa.eu/energy/efficiency/ecodesign/forum_en.htm
   第七次論壇工作報告 27-29 05 2008 Meeting 07 - 27 & 29/05/2008
   Annex 2:
   Working document on possible eco design requirements for single stage end suction, vertical multistage and submersible multistage pumps
3. Appendix 6:
   Lot 11-Water Pumps (in commercial buildings, drinking water pumping, food industry, agriculture).

2.1 泵浦效率-比速率-流量曲線模擬

A method to define a minimum level for pumps efficiencies based on statistical evaluations
Technical University Darmstadt, 17,09,2007

The efficiency of the pump shall be tested as described in this Annex and in accordance with EN ISO 9906-1999 class 2.

The mathematical description of the efficiency levels is based on the following equation[1]:

$$\eta_{BOT} = -11.48\,x^2 - 0.85\,y^2 - 0.38\,xy + 88.59\,x + 13.46\,y - C$$

with
$x = \ln(n_s)$ with n_s in $[min^{-1}]$
$y = \ln(Q)$ with Q in $[m^3/h]$

$$Ns=rpm*(m^3/sec)^{0.5}/(m)^{0.75}$$

上式中的比速率之流量計算單位=m^3/sec
但在計算效率時的流量計算單位=m^3/hr

2.2 先推動C10%的產品效率-只有10%達不到要求，目前是推動C40

a) First staged minimum energy efficiency requirement

One year after the proposed implementing measure comes into force, the C = 10% value will apply for the measurement of energy efficiency of a pump. Values of C for each type of pump are shown in table 1.

單級端吸(ES)/立式多級(MS)/沉水深井(MSS)

Table 1: Values for pump energy efficiency levels

	Quantity cut-off									
	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%
C (ESOB 1450)	134.38	132.58	131.70	130.68	129.35	128.07	126.97	126.10	124.85	122.94
C (ESOB 2900)	137.28	135.60	134.54	133.43	131.61	130.27	129.18	128.12	127.06	125.34
C (ESCC 1450)	134.39	132.74	132.07	131.20	129.77	128.46	127.38	126.57	125.46	124.07
C (ESCC 2900)	137.32	135.93	134.86	133.82	132.23	130.77	129.86	128.80	127.75	126.54
C (ESCCI 1450)	138.13	136.67	135.40	134.60	133.44	132.30	131.00	130.32	128.98	127.30
C (ESCCI 2900)	141.71	139.45	137.73	136.53	134.91	133.69	132.65	131.34	129.83	128.14
C (MS 1450)	134.83	134.45	133.89	132.97	132.40	130.38	130.04	127.22	125.48	123.93
C (MS 2900)	139.52	138.19	136.95	135.41	134.89	133.95	133.43	131.87	130.37	127.75
C (MSS 2900)	137.08	134.31	132.89	132.43	130.94	128.79	127.27	125.22	123.84	122.05

2.3 最終目標C80%--提升效率至現有最佳效率的前20%

b) Second staged minimum energy efficiency requirement

Four years after the proposed implementing measure comes into force, the C=40% cut-off values indicated in Table 1 will apply for the measurement of energy efficiency of a pump.

c) Product information requirement

One year after the proposed implementing measure comes into force, labelling of the top 20% efficiency pumps must be proposed as a basis for a one-level 'best in class' efficiency label based on the corresponding C values.

d) Benchmark for best products

The benchmark for best product in terms of energy efficiency is the C=80% values.

2.4 單級端吸離心泵的分類與性能範圍

1. Single stage end suction water pumps in three categories:

- end suction own bearing (ESOB);
- end suction close coupled (ESCC);
- end suction close coupled in-line (ESCCi)

Limits: QBEP min = 6 m^3/h, ns min = 6 rpm,
ns max = 80 rpm, P max = 150 kW
H max = 90 m at 1450 rpm,
H max = 140 m at 2900 rpm

2.5 立式多級離心泵的分類與性能範圍

2. Vertical multistage (MS) water pumps with characteristics as follows:

- operating temperature between -10 and +120°C;
- vertical multistage pumps in in-line and ring section design;
- 2900 rpm pumps only;
- efficiency is measured and judged on the basis of a 3 stage pump.

Limits: QBEP ≤ 100 m³/h, n = 2900 rpm

2.6 沉水多級深井泵的分類與性能範圍

3. Submersible multistage (MSS) pumps with nominal size 4" and 6".

3. 計算工具


泵浦媒體圖書館
https://www.uberty.com.tw/page/about/index.aspx?kind=9
泵浦媒體圖書館
泵浦教室 最新消息 檔案專區 計算工具 節能案例 知識分享 影片動畫 聯絡我們
計算工具
計算工具1-泵浦總效率計算泵浦總效率計算
case1泵浦總效率計算
計算工具2-歐盟泵浦效率與軸功計算
計算工具3-歐盟泵浦效率計算與IE3馬達規格
計算工具4-泵浦節能評估
計算工具5-管路阻抗曲線編號建立
計算工具6-需求流量與揚程計算
計算工具7-管路系統搭配泵浦
計算工具8-泵浦搭配管路系統年耗電量
計算工具1-泵浦總效率計算泵浦總效率計算
www.uberty.com.tw
計算歐盟泵浦能效-case1
泵浦總效率計算
H、Q數據：輸入流量Q(選擇單位)、揚程H(單位公尺)，先選擇輸入流量的單位，確認流量單位的轉換。
電源數據：輸入轉速電壓V、電流A、功因，得到耗電功kW。
馬達轉速：輸入頻率Hz、極數pole，得到同步馬達轉速rpm與感應馬達轉速rpm。
請選泵浦迴路 開迴路 請選擇泵浦型式 ESOB
確認泵浦型式
選擇泵浦入口直徑尺寸mm 40 選擇泵浦出口直徑尺寸mm 32
選擇泵浦葉輪直徑尺寸mm 100
確認完整泵浦型號