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Properties of HT980 Steel Plates and Welding Materials with Low Cold Cracking Susceptibility and Their Applicability to Penstocks

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u R ¹ « £ - ' + È H 9 ¾ r @ ~ y Z C x K ³ v /] " È l M 50 # 5 2 75 mm 0 @ ~ C x S HT980 º l # 5 2) 0 SMAW È SAW È MAG } b # 5 2 TIG } b £ j e : ¼ ¥ ' * y \ } b H 9 µ Ä 0 H 9 ¾ r @ ~ y Z 1 SMAW , 75ÊC Æ P z . ' È Á Q t É 30Ê

予熱低減型 HT980 鋼板および溶接材料の特性と

Properties of HT980 Steel Plates and Welding Materials with Low Cold Cracking Susceptibility and Their Applicability to Penstocks

要旨

水圧鉄管用として，割れ阻止予熱温度低減化要求に応え，板厚50 および 75 mm の予熱低減型 HT980 鋼板およびその SMAW

Table 1 Target properties of HT980 steel plates and their welded joints

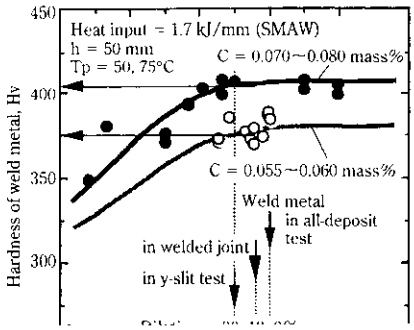
Thickness (mm)	Base metal							Welded joint				Preheat temp. to prevent cracking* (°C)
	YS (MPa)	TS (MPa)	El (%)	RA (%)	vE (J)	vTrs (°C)	Crack arrest fracture toughness at 0°C (MPa·m$^{1/2}$)	TS (MPa)	vE (J)	vTrs (°C)	CTOD at 0°C (mm)	
50	≧885	950–1 130	≧12	≧25	vE −55°C ≧47	≦−55	≧224	≧950	vE −10°C ≧47	≦−10	≦0.098	≦75
75	≧885	950–1 130	≧12	≧25	vE −60°C ≧47	≦−60	≧224	≧950	vE0°C ≧47	≦0	≧0.081	≦75

*Atmosphere: 30°C, 80%, SMAW: Using as-dried electrode

[redacted]

目違い＝6 mm）として求めると，板厚 50 mm の鋼板の場合 6.491 × 10^{-3}，板厚 75 mm の鋼板の場合 5.835 × 10^{-3} となる。欠陥特性寸法と評価手法から，破壊靭性の目標値（CTOD 値）は板厚 50 mm

ついて，その初層溶接金属の耐低温割れ性向上の設計指針を述べる。拡散性水素量と溶接金属硬さを変化させた SMAW 棒を使用して低温割れの発生を調査した例を Fig. 2 に示すが，耐低温割れ性を向


Heat input = 1.7 kJ/mm (SMAW)
h = 50 mm
Tp = 50, 75°C
C = 0.070～0.080 mass%
C = 0.055～0.060 mass%
Weld metal
in all-deposit
test
in welded joint
in y-slit test
Hardness of weld metal, Hv
450
400
350
300

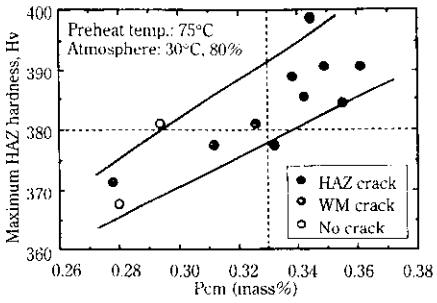
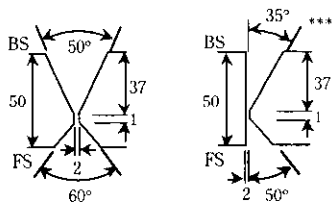
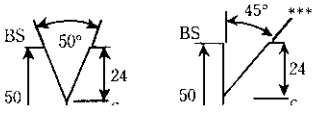

Preheat temp.: 75°C
Atmosphere: 30°C, 80%
HAZ crack
WM crack
No crack
Maximum HAZ hardness, Hv
400
390
380
370
360
0.26
0.28
0.30
0.32
0.34
0.36
0.38
Pcm (mass%)

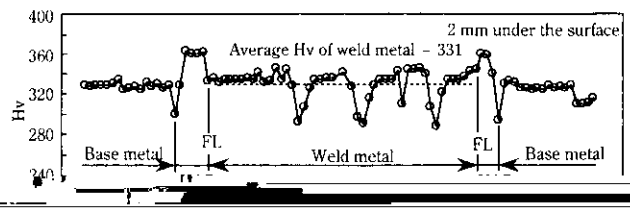
Table 2 Chemical compositions of steel plates and welding materials

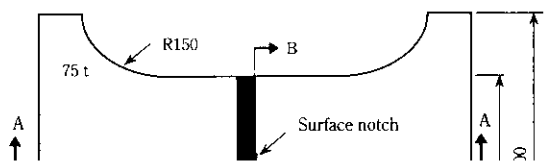
(mass%)

Steel or welding material	Thick-ness	C	Si	Mn	P	S	Cu	Ni	Cr	Mo	V	Nb	Al	B	Ceq (WES)*1	Ceq (IIW)*2	Pcm*3

Table 4 Welding conditions

Steel	Thickness (mm)	Welding method	Welding material	Groove shape (mm)	Cur. (A)	Volt. (V)	Speed (cm/min)	Heat input (kJ/mm)
A	50	MAG	KM-100		270～310	33～35	22～27	2.1～2.7
		SAW	KB80C		600～650	32～36	30～40	3.1～4.4


400
360
320
280
240
Hv
2 mm under the surface
Average Hv of weld metal = 331
Base metal
FL
Weld metal
FL
Base metal


R150
B
75 t
A
Surface notch
A
10

TIG 溶接では 50℃ 以下でよ HT780 鋼と同等の耐溶接割れ

5 結 言

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