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西安威特电力电子设备研究所

Weite Power Electronic Equipment Research Institute Xi'an

燃气预热后铝棒变频梯度加热炉

Aluminum bar induction temperature gradient heating furnace after gas preheating



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燃气预热后威特变频梯度加热炉，
每吨铝棒只需10~15度电，
即可完成梯度加热，节省燃气15~20%，
总费用低于纯燃气加热

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威特

变频感应梯度加热原理 简介

VARIABLE FREQUENCY INDUCTION GRADIENT HEATING PRINCIPLE

变频感应梯度加热是通过变频电源将供电工频电流，输出为合适频率的电流，将该电流输入由加热炉感应线圈组成的谐振回路中，使炉体线圈产生交变磁场，欲加热的铝棒处于该交变磁场中，使其自身产生交变电流而发热，因而热效高、耗能低。通过变频电源可精确控制磁场强度在同一根铝棒轴向的分布，因而铝棒温度在轴向呈渐变梯度，即可实现从同一铝棒头部到尾部温度逐渐变低的梯度加热。该渐变梯度可通过控制系统精确控制任意设定。

Variable frequency induction gradient heating is to convert power frequency current to current with suitable frequency by variable frequency power supply and input the current with suitable frequency into resonance circuit composed of heating furnace induction coil to make furnace coil generate alternating magnetic field, with aluminum bar to be heated in the alternating magnetic field to make it generate alternating current and heat and achieve high heat efficiency and low energy consumption. Variable frequency power supply is able to carry out precise control of axial distribution of magnetic field intensity along one aluminum bar and taper off magnetic field intensity. Accordingly, temperature on aluminum bar shows gradual change gradient along axial direction to achieve gradient heating from high temperature in head to low temperature in tail of aluminum bar. The gradual change gradient may be freely set by control system.

燃气预热后威特变频梯度加热炉，每吨铝棒只需 10 ~ 15 度电，即可完成梯度加热，节省燃气 15 ~ 20%，总费用低于纯燃气加热

10% electric energy can be completed gradient heating per ton of aluminum gradient heating costs less than 15 yuan to increase the cost of only 10 yuan (RMB)

燃气预热后变频梯度加热设备优点

AFTER GAS PREHEATING, VARIABLE FREQUENCY GRADIENT HEATING EQUIPMENT IS CHARACTERIZED BY

1. 总加热费用低，预热可用燃气、煤、木屑等，便宜燃料占据90%的燃料费用，减少高温段燃气消耗量，仅用5~10%电能完成梯度加热，总费用低于全燃气加热。

Low total heating cost is, with gas, coal and sawdust adopted for heating. Cheap fuel cost accounts for 90% of fuel cost, and electric energy cost accounts for 10% of fuel cost to complete gradient heating.

2. 预热温度400~500℃均可，铝棒梯度任意设定，经梯度加热后，温度精确，温度梯度呈线性分布。Preheating temperature from 400℃ to 500℃. Aluminum bar gradient is freely set, and gradient heating ensures precise temperature.

3. 透热性好，磁场对于铝棒具有很好的渗透性，非传导加热，因而铝棒表芯温差小，可提高挤压产品质量。

Favorable diathermancy. Magnetic field is permeable to aluminum bar, being non conductive heating. Accordingly, the temperature difference between surface and core of aluminum bar is small to improve quality of extrusion product.

4. 加热设备即用即开，使用方便，无附加能耗。Heating equipment ready for operation at any moment, operated conveniently.

5. 与挤压机联动，全自动运行，操作简便。In linkage with extruder, characterized by automatic and simple operation.

6. 变频电源可多级控制输出功率，铝棒轴向温差可按工艺要求设置，能量分布精确，温度梯度呈线性分布，可大幅提高产品质量。

Variable frequency power supply is able to carry out multi-level control of output power. Temperature difference along axial direction of aluminum bar may be set according to requirement of process, with precise energy distribution and linear distribution of temperature gradient to greatly improve product quality.

7. 梯度加热的铝棒，可提高挤压效率15~20%，提高成品率5%，经济效益可观。

Aluminum bar subjected to gradient heating can improve extrusion efficiency by 15%-20%, achieving considerable economic benefit.

8. 总用电容量小，不需改变原供电线路及变压器，多温区每一温区三相供电，无三相不平衡。Small total power capacity. Accordingly, there is no need to change existing power supply line and transformer.

9. 设备占地面积小，不需改变布局即可与现有加热炉配套使用。

Small floor space covered by equipments. Accordingly, there is no need to change layout to operate with existing heating furnace.

10. 短棒加热炉、长棒热剪炉均可配套使用，不需对原加热炉进行改造。

Short bar heating furnace and long bar hot shear furnace are in operation without alteration to existing heating furnace.

11. 威特自行开发的控制程序，操作全自动化。

Control program developed by Weite is automatic in operation.

变频感应梯度加热能耗指标

ENERGY CONSUMPTION INDICATORS FOR VARIABLE FREQUENCY INDUCTION GRADIENT HEATING

初始温度℃ Initial temperature℃	最终加热温度 Final heating temperature℃	最大温度梯度 ℃ Temperature gradient °C	加热时间 Heating time	耗电量 (度电/吨铝棒) Power consumption (kilowatt hour/aluminum bar/t)
380	500	100	1-2分钟/根 1-2 minutes/bar	22
400	500	100	1-2分钟/根 1-2 minutes/bar	20
425	500	70	1-2分钟/根 1-2 minutes/bar	17
450	500	50	1-2分钟/根 1-2 minutes/bar	15
470	500	30	1-2分钟/根 1-2 minutes/bar	9

不同能耗燃气炉配变频梯度加热炉总能耗费用对比

(工艺温度 500℃)

加热方式	不同能耗 燃气炉 分项加热 费用	55m ³ 燃气 / 吨铝棒	40m ³ 燃气 / 吨铝棒	25m ³ 燃气 / 吨铝棒
		纯燃气加热到500℃	燃气加热费用 $55\text{m}^3 \times 3.9\text{元}/\text{m}^3 = 215\text{元}$	$40\text{m}^3 \times 3.9\text{元}/\text{m}^3 = 156\text{元}$
燃气预热到450℃后 梯度加热到500℃	燃气预热费用	$55\text{m}^3 \times 85\% \times 3.9\text{元}/\text{m}^3 = 182\text{元}$	$40\text{m}^3 \times 85\% \times 3.9\text{元}/\text{m}^3 = 133\text{元}$	$25\text{m}^3 \times 85\% \times 3.9\text{元}/\text{m}^3 = 83\text{元}$
	梯度加热费用	15度电/吨铝 × 0.8元/KWH = 12元	15度电/吨铝 × 0.8元/KWH = 12元	15度电/吨铝 × 0.8元/KWH = 12元
	混合加热总费用	182元+12元=194元	133元+12元=145元	83元+12元=95元
混合加热比纯燃气加热节省费用		215元-194元=21元/吨铝	156元-145元=11元/吨铝	98元-95元=3元/吨铝

燃气预热后梯度加热节能减排降低总加热费用的原理:

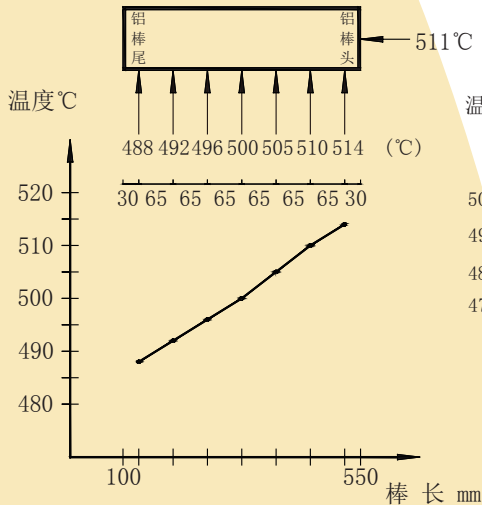
1. 铝棒温度越高，单位铝棒燃气消耗量越大，减少燃气炉高温段燃气消耗，降低铝棒燃气加热温度10%，可减少15~20%燃气消耗。
2. 梯度加热由于铝棒头部温度高、尾部温度低，燃气加热降低10%的温度、梯度加热仅需5%的电耗。
例如：原燃气加热铝棒500℃，现加热到450℃，燃气加热降低10%温度，梯度加热500℃，梯度温度50℃，则铝棒头部500℃、尾部450℃，平均升温25℃，即升温5%，所以只消耗5%电能。
3. 梯度加热5%的电能消耗即可完成原燃气炉需15~20%的燃气才能完成的高温段加热，故总费用低于纯燃气加热。

变频感应梯度加热后铝棒测温曲线

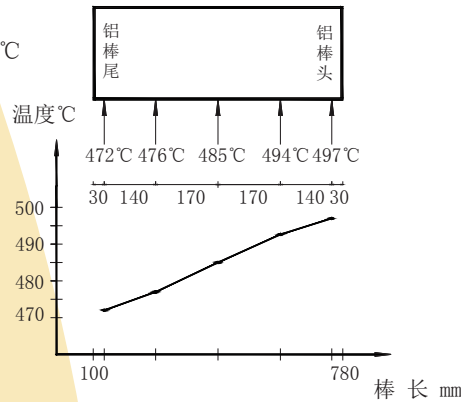
ALUMINUM BAR TEMPERATURE MEASUREMENT CURVE AFTER VARIABLE FREQUENCY INDUCTION GRADIENT HEATING

Temperature (°C)

测温点分布:



测温点分布:



直径120mm
长450mm温度梯度
Diameter: 120mm
Length: 450mm temperature gradient

直径254mm
长680mm温度梯度
Diameter: 254mm
Length: 680mm temperature gradient

注: 上述测温数据测量过程有视频资料

Note: There is video data for above mentioned temperature measurement process

不同规格铝棒梯度加热炉技术参数

TECHNICAL PARAMETERS FOR GRADIENT HEATING OF VARIOUS ALUMINUM BARS

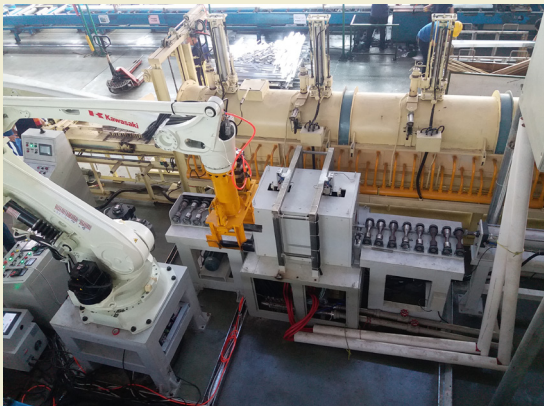
铝棒直径 (mm) Aluminum bar diameter	最终加热温度°C Final heating temperature°C	温度梯度°C Temperature gradient °C	功率 KW Power KW	加热时间 (分钟) Heating time (minutes)
100	500	0-80	20-30	0.5-1.5
120	500	0-80	30	0.5-1.5
150	500	0-80	40	0.5-1.5
178	500	0-80	50	1-2.5
203	500	0-100	60	1-2.5
254	500	0-100	80	1-3
305	500	0-100	100	1-3
350	500	0-100	150	2-5
406	500	0-100	200	4-6
大于 406 More than 406			建议采用全变频加热方式 It is proposed to adopt all variable frequency heating	

西安威特燃气预热后变频梯度加热炉使用现场

OPERATION SITE FOR VARIABLE FREQUENCY GRADIENT HEATING FURNACE AFTER GAS PREHEATING BY XI'AN WEITE



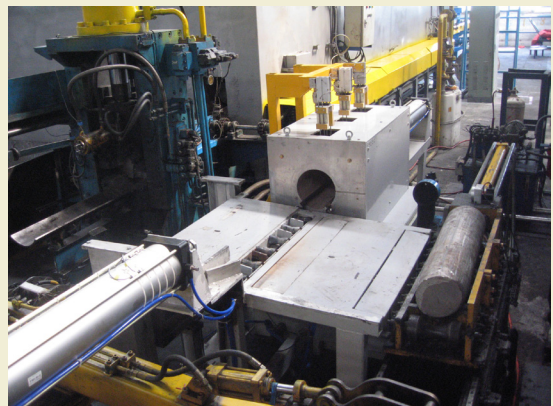
隧道式短棒燃气炉配变频梯度加热炉
Tunnel type short bar gas furnace equipped with variable frequency gradient heating furnace



机器人燃气加热炉配变频梯度加热炉
Round type gas heating furnace equipped with variable frequency gradient heating furnace



长棒热剪炉配变频梯度加热炉
Long bar hot shear furnace equipped with variable frequency gradient heating furnace



西安威特变频梯度加热炉提高挤压效率效益计算

CALCULATION OF EXTRUDING EFFICIENCY AND BENEFIT

IMPROVED BY VARIABLE GRADIENT HEATING BY XI'AN WEITE

以工业铝型材生产厂家通常计算方式:

型材价格: 铝棒价格 + 3000 ~ 5000元

一吨铝棒价格: 12000元

生产一吨铝材产值: $12000 + 3000 = 15000$ 元

毛利润: $15000 - 12000 = 3000$ 元

人工及管理费用: 1150元

非加热电费: 200元

包括: 燃气或其他加热用电、挤压、照明等综合用电

加热燃料费: 150元

纯利润: $3000 - 1150 - 200 - 150 = 1500$ 元

利润率: $1500 / (12000 + 1150 + 200 + 150) = 11.1\%$

使用威特变频梯度加热炉后, 电费增加不足20

元, 不等温铝棒提高挤压效率20-30%

相同时间和工人, 可生产型材产值:

$15000 \times 1.2 = 18000$ 元

毛利润: $18000 - 12000 \times 1.2 = 3600$ 元

人工及管理费用: 1150元

非加热电费: 200元

加热燃料及电费: 170元

纯利润: $3600 - 1150 - 200 - 170 = 2080$ 元

利润率: $2080 / (14400 + 1150 + 200 + 170) = 13.1\%$

利润率提高: $(13.1\% - 11.1\%) / 11.1\% = 18\%$

纯利润增加: $(2080 - 1500) / 1500 = 39\%$

综上所述: 普通加热方式长生1500元利润的生产时间, 梯度加热可产生利润2080元, 对于型材生产企业, 将传统加热方式改为变频梯度加热, 效益相当可观, 在不增加挤压设备及人员的情况下, 即可提高产量, 增高纯利润33%。

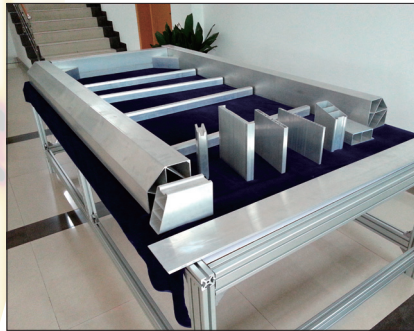
Then, if the net profit per ton of aluminum material by common heating mode is RMB 1000 yuan, the net profit after gradient heating is RMB 1390 yuan, the increased profit is RMB 390 yuan.

经梯度加热后挤压的产品

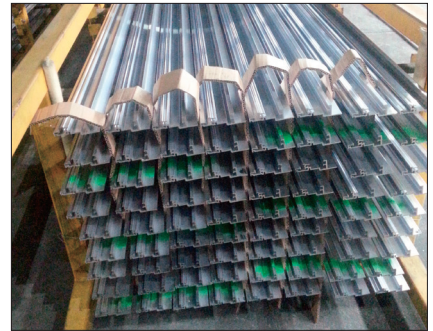
EXTRUDED PRODUCT AFTER GRADIENT HEATING



泵体等
Pump body, etc.



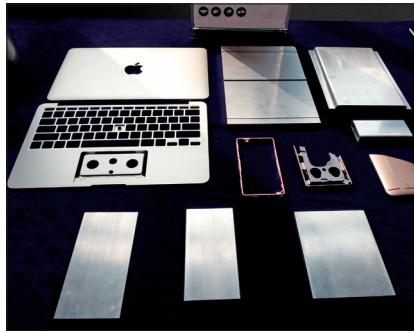
纯电动车电池箱
Pure electric vehicle battery box



BMW汽车天窗滑轨
BMW car sunroof rails



高档气缸缸体
High grade cylinder block



手机电脑用材
Mobile computer materials



运动自行车
Sport bike