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Oilon Burner Technology
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Topics 主题大纲

1. Low NOx boiler design 低氮锅炉设计
2. Combine emission deduction with energy saving, low emission technology should be applied under premise of high efficiency of boiler. 实现节能减排，低氮技术的应用需在锅炉高效运行的前提下。
3. Heat pump application, from the angle of energy saving and emission deduction of boiler system. 从锅炉系统节能减排的角度谈热泵应用

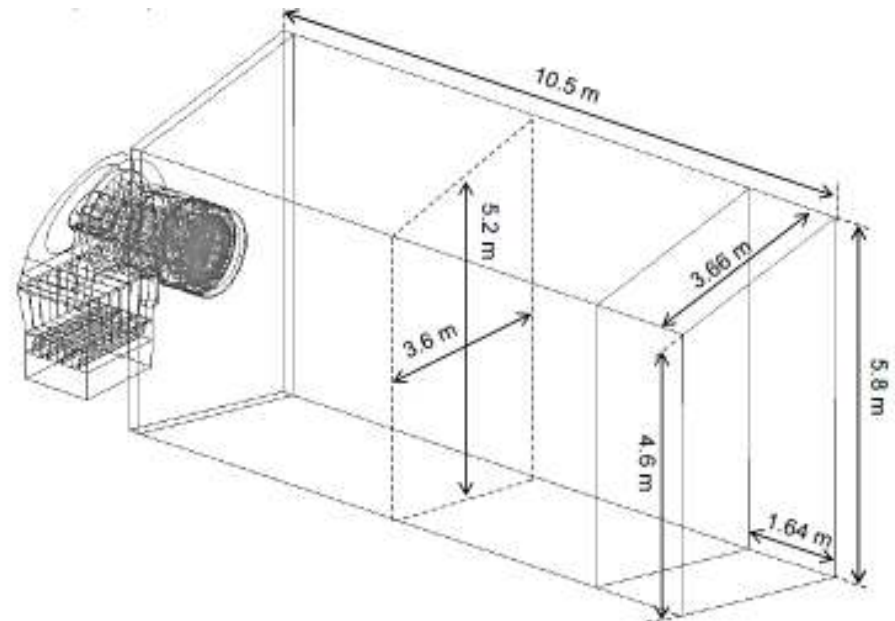
Low NOx boiler design, how we see things

低氮锅炉设计，我们认为

1. Price competition in boiler market is very hard 锅炉市场的价格竞争很激烈
 1. Customers seeking lowest price desperately and risking workability 客户拼命寻求最低的价格，但是存在适用性的风险
 2. There are companies who wants always sells the cheapest 有些企业总是以低价竞争
2. Boiler companies try to minimize its cost 锅炉公司想要降低成本
 1. Easiest way to reduce cost is to minimize furnace size 最简单的方式是最小化炉膛尺寸
3. However furnace size plays important role in Low nox and high efficiency boiler solution 然而炉膛尺寸咋低氮高效的锅炉方案中起着重要作用
4. Motivations are in conflict 动机相冲突
5. Right solutions are known, but borders are streched all time 我们已知合适的方案，但是边界总是被延伸。

Low NOx boiler design, furnace dimensions 低氮锅炉设计，炉膛尺寸

- The emission performance of a burner does always depend strongly from the boiler it is installed. 燃烧器的排放性能总是和锅炉的安装密切相关。
- When estimating the emission levels for a certain case, first thing is to consider the furnace dimensions. 当为某个项目估算排放水平时，首先要考虑炉膛尺寸
 - For NOx performance point of view the width and height are the most important factors, because they determine the base level for internal flue gas recirculation. 从NOx角度来看，宽度和高度是最重要的因素因为它们决定着内部烟气再循环的基本水平
 - Length is more important in order to confirm that there is no incombustible matter after the furnace. 保证炉膛后部没有不燃物，长度更重要
 - ⇒ Furnace load should be evaluated by volume [kW/m³] and also by cross-sectional area [kW/m²]. 炉膛负荷应该根据体积[kW/m³]和横截面积[kW/m²]评估



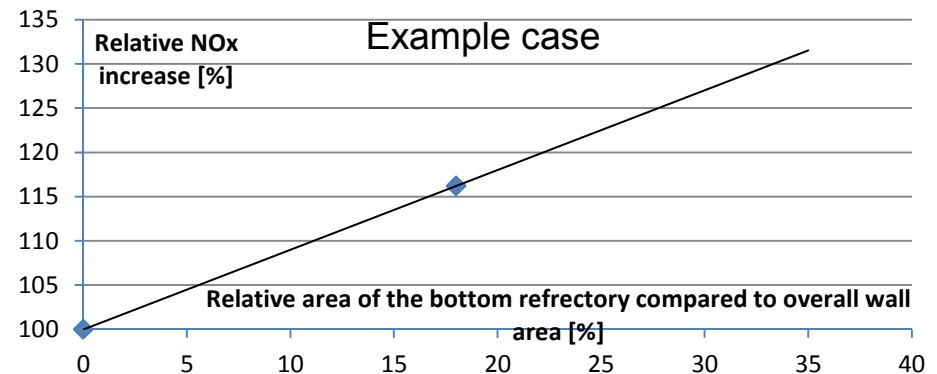
Low NOx boiler design, other aspects 低氮锅炉设计，其他因素

- Wall temperature of heat transfer surfaces inside the furnace is proportional to the total heat transfer rate from the flame into the water/steam. 炉膛内部传热表面墙温与火焰到水/蒸汽的整个传热率成比例
 - ⇒ The hotter the surface, the less heat transfers there can be.
表面越热，传热越少
 - ⇒ The less heat transfer there is, the hotter the flame will be.
传热越少，火焰越热
 - ⇒ The hotter the flame is, the more NOx emissions it will generate.
火焰越热，产生NOx排放越多
- There are multiple factors that have an impact to the wall temperature:
影响墙温的多种因素：
 1. Boiler type (hot water/steam/hot oil/etc.). 锅炉类型 (热水/蒸汽/热油/其他)
 2. Boiler pressure. 锅炉压力
 3. Furnace wall thickness. 炉膛厚度
 4. Furnace slagging. 炉膛结渣
- The most important factors are 1. and 2. 最重要的因素为1和2

Low NOx boiler design, walls 低氮锅炉设计，墙体

Furnace refractory surfaces affects the flame with many different ways: 炉膛耐火材料表面以多种方式影响火焰

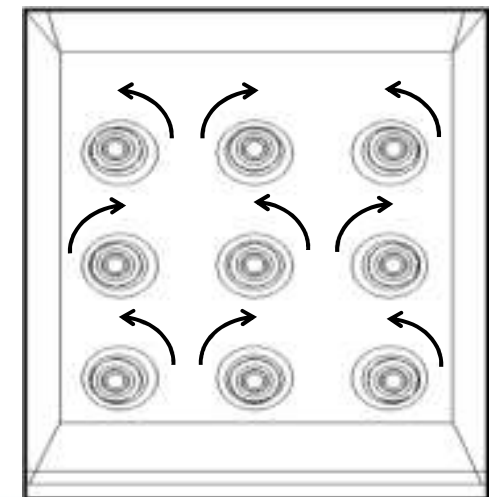
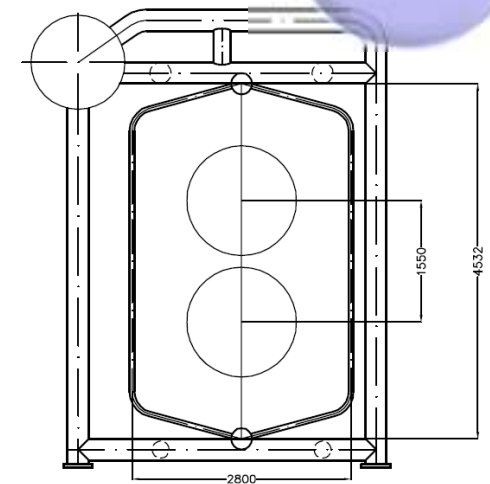
- Lowers heat transfer inside the furnace.
减缓炉膛内热传导
⇒ Flame temperature rises. NOx emissions increase. CO emissions usually decrease.
火焰温度上升，NOx排放升高，CO排放通常降低
- Flame becomes shorter. Decrease in size depends from the refractory area and placement.
火焰变短变小取决于耐火材料区域和位置
- Unsymmetrical refractory area (e.g. bottom refractory) can cause disturbances in the furnace back flow pattern due to natural convection and unsymmetrical radiation heat transfer. 不对称的耐火材料区域（例如：底部耐火材料会干扰炉膛内回流模式，由于自然对流和不对称辐射热传导）
⇒ In worst case scenario the operation of the burner can be interfered so that it will not function properly. 最坏的情况是燃烧器运行受到干扰，不能正常工作



Low NOx boiler design, burner placement 低氮锅炉设计，燃烧器排列

NOx

- It is an experimental fact, that NOx emission will increase if a flame flow pattern is influenced by another flame. 实验证明，如果火焰流量模式被另一个火焰影响，NOx排放会升高。
- Therefore optimal burner placement is crucial especially in cases with multiple burners involved. 因此优化燃烧器位置至关重要，特别是在多台燃烧器方案中
- Fundamental aspect for proper burner placement is to find locations, where single flame flow pattern is most similar compared to one burner solution. 适当的燃烧器排列基本面是寻找一个位置，单个火焰流模式和单台燃烧器方案中最为接近
 - ⇒ Not too close to walls, not too close to other flames.
离炉墙和其他火焰都不要太近
 - ⇒ Some times the furnace is not optimal for the exact number of burners that client wants. In these cases it is our duty to suggest different number of burners in order to minimize NOx emissions, investment costs and safety risks. 有时候，炉膛对于客户要求的燃烧器数量来说并不是最优，在这种情况下，我们有责任去建议调整燃烧器的数量，以最优化NOx排放，投资成本 and 安全性。
- In a multi burner solutions with three or more burners the swirl direction is also an important aspect in order to guarantee perfect burn out and minimal NOx's.
在多台燃烧器的方案中，当有3台或超过3台燃烧器，漩涡方向也是保证燃烧性能和最小Nox排放值的重要因素
- One burner per boiler solution is normally optimum in point of NOx formation
单台燃烧器，从NOx形成角度而言，通常是最佳方案。



Low NOx boiler design, case example fire tube boiler

低氮锅炉设计，以火管锅炉为例

- Straight firetube vs. corrugated firetube, effect for Nox
平直型火管 相比 波纹型火管, 对NOx的影响
 - Results calculated by CFD 结果由CFD计算
- Water cooled front wall and back wall effect for Nox
水冷前墙和后墙, 对NOx的影响
 - Results calculated by CFD 结果由CFD计算

Low NOx boiler design, working Co-operation, example

低氮锅炉设计，协同合作，案例

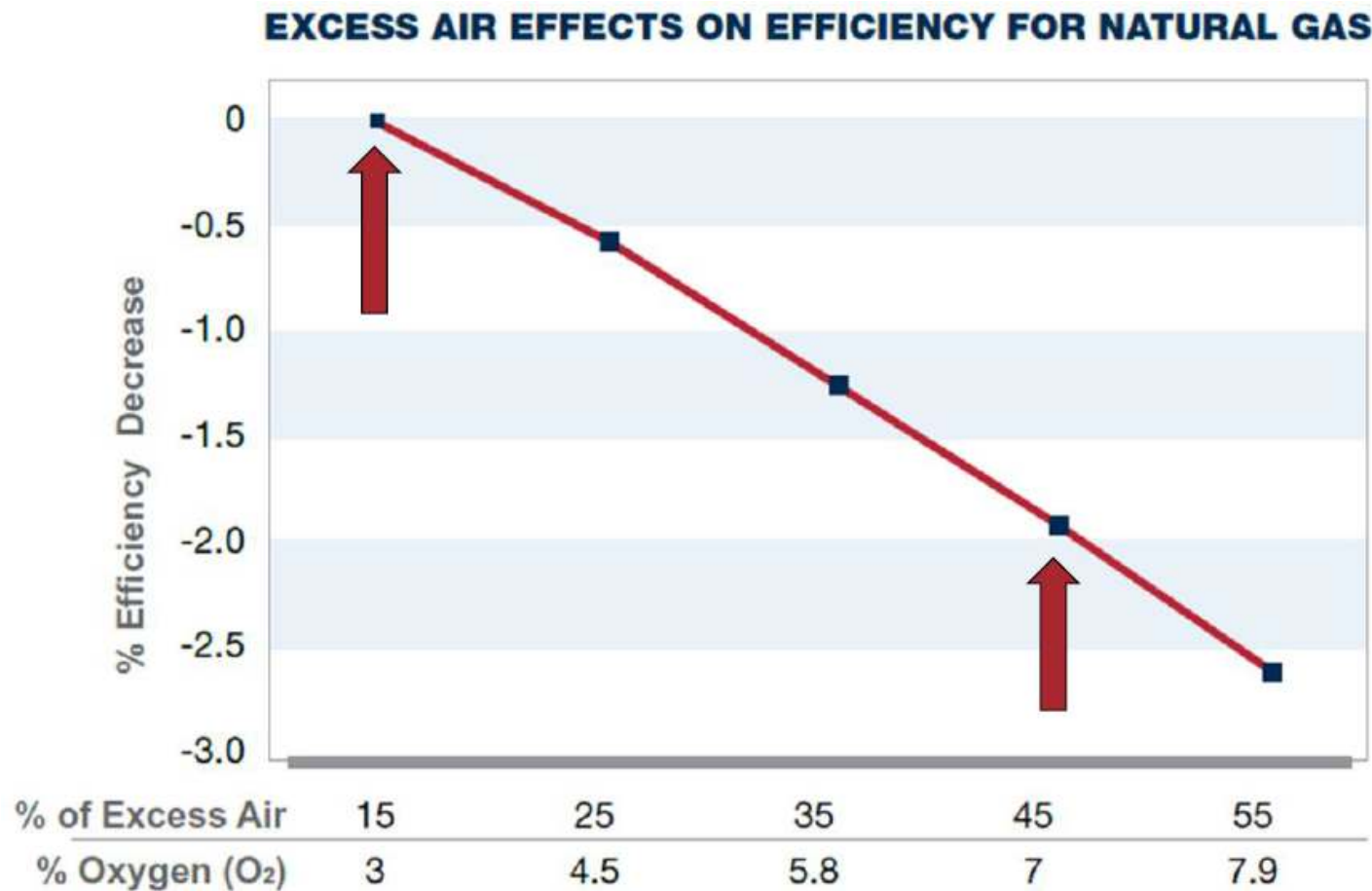
- If standard furnace is too small for Low NOx, boiler company redesign furnace according to requirements or selects bigger standard furnace to meet requirement.
如果标准炉膛对于低氮要求来说太小，锅炉公司根据要求重新设计炉膛，或者选择更大的标准炉膛来满足要求。

Combine emission deduction with energy saving, low emission technology should be applied under premise of high efficiency of boiler.

实现节能减排，低氮技术的应用需在锅炉高效运行的前提下

- Depending level demand 根据排放水平要求
- High efficiency leads higher NOx emissions and vise versa
高能效导致更高NOx排放, 反之亦然
 - Small furnace size ++ Nox 小炉膛尺寸++NOx
 - High flame temperature 高火焰温度
 - Flue gas recirculation – Nox 烟气再循环—NOx
 - Higher electricity consumption 更高电耗
 - Higher stack loss 更高烟道损耗
 - High excess air – Nox 高过量空气—NOx
 - Higher electricity consumption 更高电耗
 - Higher stack loss 更高烟道损耗

Combine emission deduction with energy saving 节能减排



Combine emission deduction with energy saving 节能减排

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Heat pump application, from the angle of energy saving and emission deduction of boiler system.

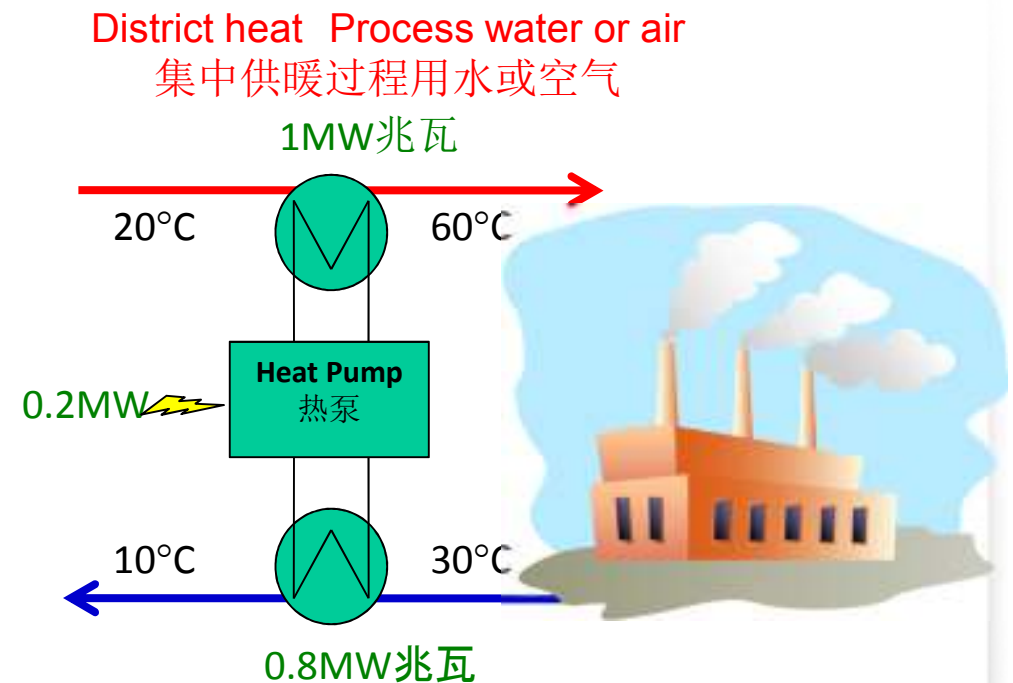
从锅炉系统节能减排的角度谈热泵应用

1. Heat pump application, from the angle of energy saving and emission deduction of boiler system.
从锅炉系统节能减排的角度谈热泵应用

Scancool Heat Pumps for Industrial Heating and Cooling 用于工业供暖和制冷的斯堪库尔热泵

Combination of heat pump and boiler results in superior energy efficiency and process availability

热泵和锅炉的结合实现了超高能效和保证了过程可靠性



Possible heat sources 可能的热源:

- Refrigeration condensers 制冷冷凝器
- Process water 工业过程用水
- Waste water 废水
- Exhaust or combustion gases 废气和燃烧气体
- Hot air 热空气
- Ground heat 地热

Heat pump application, from the angle of energy saving and emission deduction of boiler system.

从锅炉系统节能减排的角度谈热泵应用

1. Basic Connections 基本联接

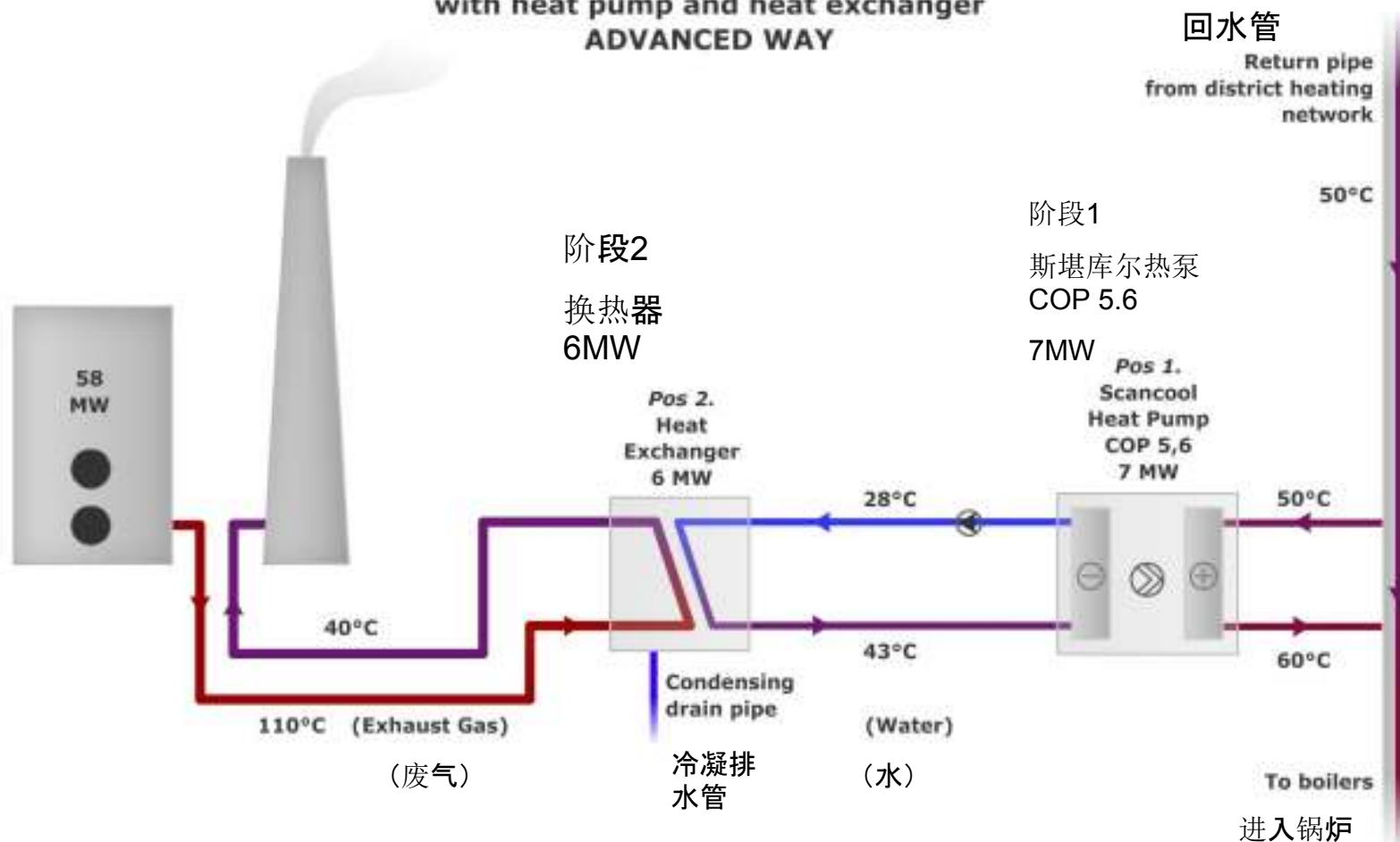
1. Advantages between connections 联接优势

用热泵与换热器从废气中进行热量回收

Heat recovery from exhaust gas
with heat pump and heat exchanger
ADVANCED WAY

集中供热管网

回水管



POS 1. 阶段1



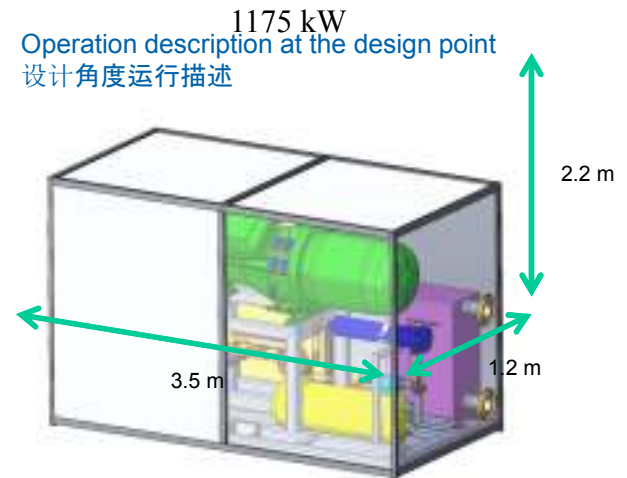
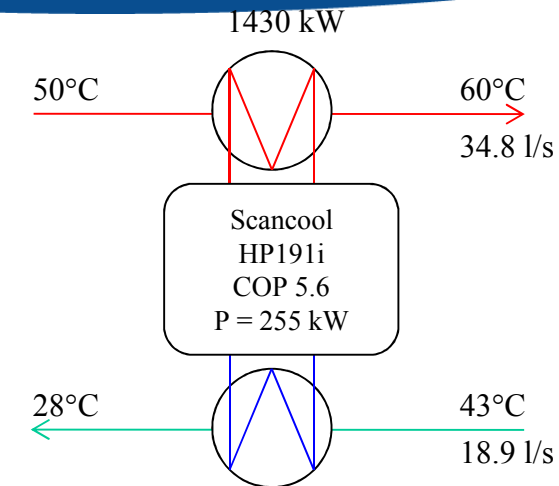
5 x Scancool HP191i

- Connection and operation ready heat pump package in liftable steel frame 联接与运行准备, 热泵组在升降架上
- Electrical central for all heat pump units and for water pumps 所有热泵组与水泵组的电气中心
- Secondary circulation water pump 二次循环水泵 690 m³/h
- PLC-automation for heat pump and water pumps and valves closely related to heat pump operation PLC自动控制系统, 用于操作热泵, 水泵及与热泵运行密切相关的阀门
- Operation and technical documentation 运行技术说明书

Technical details of HP191i: HP191i技术参数:

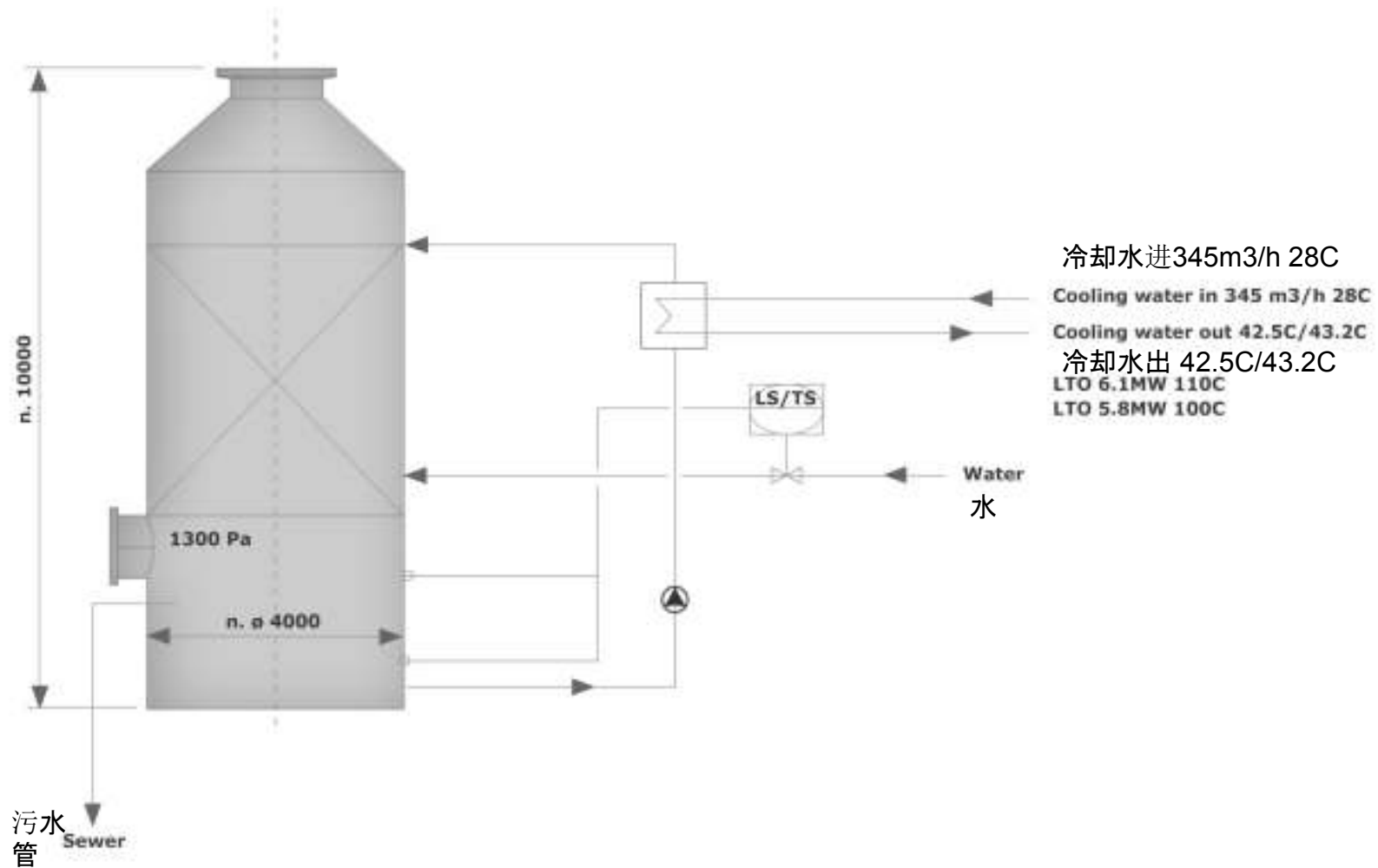
- Screw compressor controlled by VSD 由变速驱动控制的螺杆式压缩机
- HFC R134a refrigerant 冷箱 (ODP=0)
- Braze plate heat exchangers AISI 316 钎焊板式换热器 AISI 316
- Pressure loss in cold side 冷面压损 90 kPa
- Pressure loss in hot side 热面压损 90 kPa
- Grafical user interface Grafical用户界面

The accuracy of technical details presented in this quotation is $\pm 5\%$. 此报价中的技术参数的准确度为 $\pm 5\%$.



Scancool HP191i heat pump, weight 4 t, acoustic hood is not included
Totally 5 x 4 ton = 20 tón (L*W*H = 5 x 3,5 x 2,2m)

POS 2. 阶段2



Simple comparison of today situation and advanced heat recovery solution offered

现有情况和奥林提供的先进的余热回收解决方案简要对比

		现有 TODAY	Heat recovery, advanced way Heat pump + Heat exchanger	余热回收，先进方法 热泵+换热器
锅炉功率	Boiler capacity	58	58	MW
锅炉效率	Boiler efficiency appr.	94,0 %	94,0 %	
锅炉烟气温度	Flue gas temperature from boiler	110	110	deg C
回水温度	Return water temperature	50	50	deg C
天然气消耗	Natural gas consumption	61,7	61,7	MW
炉身烟气温度	Flue gas temperature to stack	110	40	deg C
烟气余热	Heat from exhaust gas approx.	0	6,1	MW
热泵热能	Heat from heat pump approx.	0	7,2	MW
助燃空气风机				
热泵能效比	Combustion air fan appr.	0,18	0,23	MW
热泵用电量	Heat pump COP		5,60	
循环泵	Heat pump electricity use appr.		1,28	MW
耗电量	Circulation pumping appr.		0,05	MW
	Electricity consumption	0,18	1,56	MW
产生热能				
	Heat produced	58,0	65,2	MW
总能耗				
效率（天然气降低热值）	Total energy consumption	61,9	63,3	MW
	Efficiency (NG lower heat value)	94 %	103 %	
提高功率	Capacity increase	0 %	12 %	

投资可行性计算

Investment feasibility calculation

8.12.2011 TTu

锅炉功率
锅炉效率
炉身烟气温度
热泵热能
天然气消耗

Boiler capacity
Boiler efficiency
Flue gas temperature to stack
Heat from heat pump
NG consumption

助燃空气风机电耗
热泵能效比
热泵电耗
循环泵电耗
增加耗电量

Combustion air fan electricity consumption
Heat pump COP
Heat pump electricity consumption
Circulation pumping electricity consumption
Electricity consumption increase

产生热能
热能可变成成本
节省

Heat Produced
Variable cost of heat
Save

每年运行时间(小时)

Operation hours per year

节省
节省

Save
Save

投资(设备交付)
投资包括进口关税
及其他税
投资回报周期

Investment (machine delivery)
Investment including import duty and tax
Simple payback

计算基于以下数据和假设

Calculation is based on following figures and assumptions:

电费
天然气价格
汇率
进口关税
增值税
未考虑运输、安装和其他可能费用

Price of electricity
Price of gas
Currency exchange rate
Import duty
Tax

现有 TODAY	热泵和换热器 Heat pump + Heat exchanger	
58	58	MW
94,0 %	94,0 %	
110	40	deg C
0	7,15	MW/h
61,7	61,7	MW/h
0,18	0,23	MW
0	5,6	
0	1,28	MW
0	0,05	MW
0	1,6	MW
58	65,2	MW/h
339	323	RMB/MWh
	1051	RMB/h
7000	7000	h
0	7354163	RMB / year
0	866164	€ / year
0	1810000	€
0	2329470	€
	2,7	Years

1	RMB / kWh
0,3	RMB / kWh
1 € = 8,4905 RMB	
10 %	
17 %	

Transportation, installation and other possible costs are not taken account

Heat pump application, from the angle of energy saving and emission deduction of boiler system.

从锅炉系统节能减排的角度谈热泵应用

1. Ongoing projects, Size, connection, COP, Refrigerant etc.

正在进行的项目，功率，联接，能效比，制冷剂，等等。

Main Arguments

主要争议

- 12% more capacity with the same gas consumption
9 plants using new technology give more energy than 10 conventional plants ($9 \times 65 \text{ MW} > 10 \times 58 \text{ MW}$)
消耗同样的燃气, 功率增加12%
——9个锅炉房采用新技术后比10个普通锅炉房产生更多的能量
($9 \times 65 \text{ 兆瓦} > 10 \times 58 \text{ 兆瓦}$)
- 5% decrease in variable energy cost
可变能源成本下降5%
- Less CO₂ and NO_x emissions
二氧化碳和氮氧化物排放减少
- Possibility to produce cooling in summer time (option)
可能实现在夏季制冷(可选项)
- Become forerunner in utilizing newest environmentally-friendly technology in China
成为中国利用最新的环保技术的先驱

Summary 总结

- Combustion efficiency 燃烧效率

Thank you for your interest!

感谢您的关注！

We treat our customers like our friends.
We listen and solve the challenges together
with customers in a warm way.

我们视客户为朋友，
聆听他们的需求，
与之携手笑迎挑战。