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50 MW 高压锅炉全燃高炉煤气的研究

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摘　要: 对 50 MW 高压锅炉全燃高炉煤气时的特性进行了详细讨论。阐述了高炉煤气锅炉稳定着火燃烧的燃烧技术和结构特点, 分析了燃用高炉煤气对锅炉热工参数、传热特性以及受热面布置的影响, 提出了适用高炉煤气的锅炉布置型式。根据研究结果制造的我国首台 50 MW 高炉煤气高压锅炉成功运行的实践证明, 该锅炉可以有效解决高炉煤气放散污染问题, 在冶金工业中有着广阔的应用前景。

关　键　词: 高炉煤气; 高压锅炉; 研究; 设计; 运行

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1　前言

近年来, 随着钢铁工业的迅猛发展, 生产中的副产煤气大量增加。焦炉煤气和转炉煤气由于发热值高, 可以在生产和生活中有效利用。而高炉煤气属低热值燃料, 受到其燃烧特性的限制, 很难作为远距离输送的生活用气, 只能在企业内部转换利用, 高炉煤气的回收利用率较低, 大量高炉煤气只能对空排放, 不仅污染大气环境, 而且浪费了可利用的二次能源。因此, 高炉煤气的有效转换和利用是钢铁企业清洁生产和节能的重要环节。因此, 研究开发高参数大容量全燃高炉煤气锅炉很有必要。

高炉煤气燃料及燃烧特性与其它高热值的固体和气体燃料有显著的区别, 全燃高炉煤气后锅炉的传热特性有很大的变化, 其受热面布置有不同的特点。本文以首都钢铁公司 50 MW 全燃高炉煤气高压锅炉为例, 分析燃用高炉煤气对锅炉燃烧状况、热工参数、传热特性以及受热面布置的影响, 为我国首台 50 MW 高炉煤气高压锅炉的研制提供了依据。

2　高炉煤气燃烧技术

2.1　高炉煤气的燃料特性

表 1 为首钢提供的煤气资料, 其主要可燃成分是 CO 和含量很少的 H_2 与 CH_4, 其余为惰性气体 CO_2 和 N_2。CO 燃烧反应产生的热值为 12 636 kJ/m^3, 属低热值气体燃料, 而且 CO 在高炉煤气中的体积百分数仅占总量的 23.15%; 另外, 高炉煤气一般采用湿式除尘净化, 除尘后的水蒸气含量增大。因此, 高炉煤气的低位发热量很低, 只有 3 240 kJ/m^3。高炉煤气的着火温度约 530 ℃～650 ℃, 比挥发份 30%的烟煤着火温度(约 750 ℃)低 100 ℃。但这并不能说明高炉煤气具有良好的着火和稳定的燃烧条件。因为: (1)高炉的大型化使高炉煤气中的可燃物含量减少, 着火浓度降低。而高炉煤气的着火浓度下限值较高, 约为 35%; (2)低热值燃料特性使高炉煤气火焰温度不高, 锅炉炉膛温度水平降低, 存在的大量惰性气体阻碍可燃成分与空气的充分混合, 减缓燃烧化学反应速度和火焰传播速度, 导致高炉煤气燃烧时会出现脱火等不稳定状态。因此, 选择具有良好着火和稳定燃烧的燃烧设备和炉膛型式是高炉煤气高压锅炉设计的首要问题。

表 1　首钢高炉煤气体积分数　%

成分	N_2	CO_2	CO	H_2	CH_4	H_2O	d_g/g·m^{-3}	Q_{dw}/kJ·m^{-3}
含量	46.73	18.95	23.65	1.67	0.2	8.8	77.5	3 240

注: 表中立方米为标准立方米

2.2　高炉煤气燃烧器

目前, 广泛应用于中、低参数的是多管式燃烧器。随着锅炉容量的增大, 该燃烧器的布置将出现困难, 原有的小孔喷射速度使燃气对空气的穿透深度不够, 造成混合不良; 提高喷射速度则燃气侧阻力增加, 需要较高的炉前燃气压力。当高炉运行工况变动时, 势必波及锅炉燃烧的稳定性。因此, 高参数大容量高炉煤气锅炉应选择燃烧稳定和燃气侧阻力较小的燃烧器。西安交通大学、首都钢铁公司和杭州锅炉厂联合研制开发的我国首台 50 MW 全燃高炉煤气高压锅炉, 结合套管式燃烧器和旋流式燃烧器的特点, 采用的是双旋流平面火焰燃烧器, 如图 1 所示。燃气和空气分别流经内、外套管的环行通道, 通道内均布置有轴向导流叶片, 燃烧器中心留有油枪点火通道。经锅

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炉运行证明该燃烧器有以下几个方面的优点。

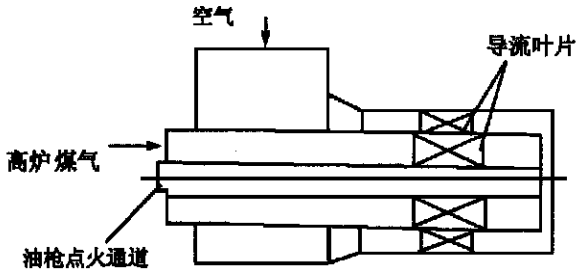


图 1 双旋流燃烧器

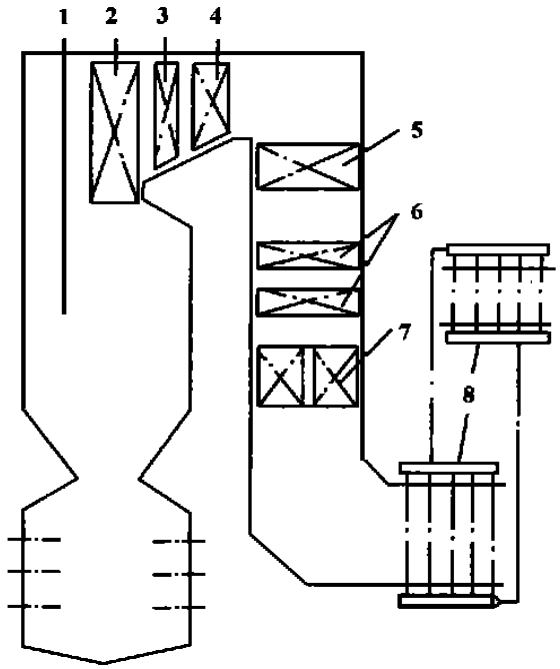
(1) 着火性能好, 燃烧稳定。燃气和空气在环行通道中作螺旋运动离开燃烧器时, 在离心力的作用下进行紊流扩散形成环状气流, 并从内外两侧卷吸周围的介质。两股旋转气流之间存在较大的相对速度, 混合强烈。扩散燃烧火焰温度不太高但较均匀, 火焰稳定好, 不会出现回火及脱火现象。由于两股气流离开燃烧器后均存在切向速度, 气流的扩展角增大, 有利于中心回流区卷吸高温烟气, 增加了着火稳定性。实践表明, 该燃烧器适用于超低热值高炉煤气。气体燃烧时呈现一个很大的平面火焰锋面, 充满度好。

(2) 阻力特性好, 总阻力水平较低。双旋流燃烧器与多管式燃烧器相比较, 降低了燃气从小孔高速度喷出时消耗的压降, 燃气能以相对较低的速度进入炉膛, 不会增加气流旋转和产生涡流消耗的能量, 并且适应高炉煤气气源压力波动的工况。运行表明, 在满负荷运行时炉前压力为 1 500 Pa, 比其它类型的燃烧器少 65%。此外, 良好的阻力特性为加装煤气预热器创造了有利条件, 可以使燃气达到足够高的预热温度。

(3) 单只功率大, 负荷调节性能良好。由于双旋流燃烧器的阻力低, 燃气和空气的混合过程不在燃烧器内部进行, 可以减小燃烧器尺寸, 有利于单只燃烧器向大功率方向发展, 使燃烧器达到较高的热负荷。同时, 双旋流混合扩散燃烧方式可以适当缩短火焰长度, 增加着火稳定性, 因此扩大了负荷调节范围。首钢 50 MW 锅炉单只燃烧器处理高炉煤气量可达 15 000 m^3/h, 单只热功率达 14 MW, 负荷变化范围为设计功率的 25%~110%。

3 高炉煤气高压锅炉受热面的布置

50 MW 高炉煤气高压锅炉受热面的布置见图 2。炉膛为缩腰式炉型, 前、后墙共布置 15 个双旋流燃烧器, 前墙 9 个(3×3), 后墙 6 个(2×3)。为保证稳定燃烧, 炉膛后墙上排还布置有 3 个油燃烧器(运行中未投用)。过热器系统由屏、高温过热器和低温过热器组成, 过热蒸汽流程为炉顶管—包墙管—低温过热器—屏—高温过热器。经济器和空气预热器为单级布置, 尾部是分离式热管煤气预热器。



1— 炉膛; 2— 屏式过热器; 3— 高温对流过热器; 4— 低温对流过热器; 5— 高温经济器; 6— 低温经济器; 7— 空气预热器; 8— 分离式热管煤气预热器

图 2 炉膛受热面布置示意图

锅炉规范: 额定蒸汽流量 220 t/h, 过热蒸汽压力 9.8 MPa, 过热蒸汽温度 540 ℃。

3.1 炉膛

高炉煤气燃烧时的理论燃烧温度比高热值的燃料低得多。一般烟煤、油和天然气的理论燃烧温度约 1 800 ℃~2 200 ℃, 而高炉煤气即使经过预热(一般小于 200 ℃)的理论燃烧温度也只有 1 300 ℃~1 450 ℃。这样低的理论燃烧温度要保证炉内燃烧的稳定性, 除了选择合适的燃烧器外, 炉膛结构型式也非常重要。研制的 50 MW 高压锅炉采用了缩腰式炉型布置, 缩腰后在炉膛下部形成一个全部敷设卫燃带的燃烧室。计算表明, 燃烧室面积约占炉膛辐射受热面积的 27%, 而吸热量占炉膛吸热量的 10%。这表明燃烧室内的烟气与炉壁的热交换大为减弱, 有助于各排燃烧器的稳定着火和燃烧, 防止熄火现象的发生。

表 2 为炉膛热力计算结果。高炉煤气理论燃烧

温度比烟煤低 650 ℃, 火焰黑度约比烟煤减弱 45%, 使得炉膛辐射换热量大大减少, 比燃用烟煤时降低了 39.3%。而炉膛的辐射受热面却需要增加 15.9%, 辐射受热面面积热负荷降低 47.6%。此时炉膛出口烟温已比燃煤锅炉低 50 ℃左右, 若进一步降低炉膛出口温度, 增大炉膛的辐射换热量, 会导致: (1)炉膛火焰平均温度的下降, 影响高炉煤气的稳定燃烧; (2)辐射受热面金属利用率进一步降低, 炉膛水冷壁每增加 50 m^2 仅使炉膛出口烟温降低 8.9 ℃; (3)对流受热面传热温压减小, 受热面积增加。因此, 炉膛出口烟温的选择可与燃煤锅炉相似, 通过布置其它蒸发受热面的方法以弥补炉膛蒸发吸热量的减少。

表 2　炉膛技术数据

燃料种类	辐射受热面积 / m^2	理论燃烧温度 / ℃	出口烟温 / ℃	吸热量 / MW
烟　煤	756.9	1 995	1 027	95.2
高炉煤气	877.4	1 347	981	57.8

3.2　过热器

高参数锅炉的过热汽温一般约为 540 ℃~555 ℃。工质的过热吸热量占总吸热量的 29.3%~36.0%左右, 过热蒸汽的汽温特性主要受到受热面布置的影响。对于 50 MW 高压锅炉, 在炉膛出口处布置有半辐射式受热面——屏式过热器和辐射式炉顶过热器, 吸收炉膛大部分的辐射热量, 其它过热器基本上作为对流受热面。计算表明, 燃煤锅炉的辐射过热吸热量占总过热吸热量的 13.7%, 高炉煤气锅炉下降为 5.72%, 其汽温特性趋近于纯对流式过热器的汽温特性。

以对流换热为主的过热器系统, 吸收烟气热量主要取决于传热温压和传热系数。表 3 给出高温和低温过热器的计算结果。高炉煤气含有大量惰性气体, 燃烧产物的容积流量增大, 对于 50 MW 高压锅炉, 燃用高炉煤气时烟气的容积流量比燃用烟煤时大 51.1%, 相应的高温、低温过热器烟气流速提高 50%~65%, 传热系数提高 43%。此外, 容积流量增大使得烟气的热容量增加。计算表明, 烟气温度下降 100 ℃, 高炉煤气燃烧产物释放的热功率是烟煤的 1.5 倍。这说明释放相同的热量, 燃用高炉煤气时烟气的温降比燃煤时要小, 使得对流受热面的传热温压逐级提高, 到低温过热器时传热温压增加近 30%。因此, 对流过热器面积比燃用烟煤锅炉减少 36%。若炉膛布置的辐射式过热器吸热量超过一半时, 过热器受热面反而要增加, 因为对流过热器的焓增无法补偿辐射式过热器吸热量的减少。

表 3　高温和低温过热器技术数据

燃料种类	受热面积 / m^2		烟气流速 / $m \cdot s^{-1}$		传热系数 / $kW \cdot (m^2 \cdot ℃)^{-1}$		传热温压 / ℃		吸热量 / MW	
	高过	低过	高过	低过	高过	低过	高过	低过	高过	低过
烟　煤	972	870	8.7	8.7	0.066	0.060	296	241	21.01	13.92
高炉煤气	664	515	13.1	14.4	0.089	0.092	310	312	18.27	14.79

3.3　经济器

表 4 为经济器技术数据。燃煤高压锅炉中炉膛蒸发吸热量占工质从水到饱和蒸汽总吸热量的 88.1%, 而高炉煤气锅炉仅能完成其中的 55.6%, 剩余的蒸发吸热量只能由经济器来完成。计算表明, 50 MW 高炉煤气锅炉经济器的吸热量比燃煤锅炉增加 2.6 倍, 受热面积是燃煤锅炉的两倍左右。经济器需要吸收如此大的热量, 增大了受热面设计布置的难度, 主要应考虑以下三个方面:

(1) 经济器分段集中布置在较高烟温区, 可以增大传热温压和传热系数, 减少受热面积, 降低烟气侧和水侧的流动阻力; (2) 高温经济器出口工质必然出现较大的沸腾度, 工质出口的沸腾度达 11.1%; 若部分给水用于锅筒内设置的蒸汽清洗装置, 60%的给水通过经济器, 则工质出口沸腾度可高达 35%。因此, 工质水动力校核计算必须考虑水动力特性出现多值性和发生脉动现象的可能性。(3) 沸腾式经济器进口工质应保证有一定的欠焓, 防止锅炉运行工况的变化使进口集箱内工质汽化, 出现汽液两相流动分配不均匀现象。一般进口水温保持 40 ℃~50 ℃的过冷度为宜。

表4　经济器技术数据

燃烧种类	受热面积 / m^2	烟气平均流速 / $m \cdot s^{-1}$	平均传热系数 / $kW(m^2 \cdot ℃)^{-1}$	平均传热温压/ ℃	吸热量 / MW
烟　煤	1 890	8.06	0.051	133.7	12.80
高炉煤气	3 819	12.4	0.086	156.8	46.15

3.4　空气预热器和煤气预热器

高炉煤气高压锅炉应同时布置空气预热器和煤气预热器, 可以增加入炉热量, 提高理论燃烧温度, 稳定高炉煤气的着火和燃烧, 增大炉膛辐射换热量。

高炉煤气中主要可燃成分 CO 在完全燃烧时所需的氧量只有碳的一半, 因此高炉煤气锅炉入炉的空气量占烟煤锅炉的 76.6%。由于空气的容积流量和热容量比较小, 即使预热到较高的温度对理论燃烧温度的提高也不明显, 因此, 热空气温取 200 ℃~250 ℃即可。对于 50 MW 高压锅炉, 燃用高炉煤气的空预

器吸热量比燃用烟煤减少约40%,比燃用无烟煤减少约60%。这样,空预器完全可以单级布置在较低的烟温区域。

高炉煤气容积流量大,是送入锅炉空气量的1.5倍,热容量也较高。若煤气预热器布置在锅炉尾部可以有效降低排烟温度,明显提高炉膛理论燃烧温度。计算表明,高炉煤气温度每提高10 ℃,理论燃烧温度可提高5 ℃~6 ℃左右。高炉煤气预热器的布置要考虑高炉煤气的有毒性和易燃性,要求其在与热烟气的热交换中不发生任何泄漏,这对于管式预热器很难做到。大型分离式热管换热器可以实现换热过程所要求的完全严密而不泄漏。该换热装置适合回收低品位能源,通常布置在烟气流程的尾部。高炉煤气的预热温度以200 ℃左右为宜。

4 运行

首台50 MW全燃高炉煤气高压锅炉在首钢成功运行的经验显示,该锅炉采用双旋流平面火焰燃烧器、缩腰式炉膛、合理的经济器布置以及应用高炉煤气预热器等措施后,具有保证锅炉参数条件下处理高炉煤气的能力。由于高炉生产工艺的变化,高炉煤气的热值及流量也不断变化。在运行期间,高炉煤气热值的变化范围从3 300 kJ/m^{3}到2 424 kJ/m^3,流量最高时达21.4万m^3/h,最低时约为5万m^3/h,是设计处理量的110%~25%,均能保证锅炉的正常运行,说明该锅炉具有燃烧超低热值煤气和较强的变负荷运行能力,这一特点对于采用不同冶炼工艺的高炉解决高炉煤气放散尤其重要。近两年的运行实践表明所研制的高压锅炉彻底解决了首钢的高炉煤气放散污染问题,同时达到了污染物资源化处理的目的,在冶金工业中有着广阔的应用前景。

5 结论

(1) 高炉煤气是一种超低热值燃料,辐射换热能力很弱。用于50 MW高压锅炉,炉膛辐射换热量比燃煤锅炉减少39.3%,受热面积增加15.9%。炉膛采用缩腰布置和双旋流平面火焰燃烧器能够起到稳定着火燃烧的良好作用。

(2) 对于50 MW燃用高炉煤气的高压锅炉,其过热器的主要传热方式为对流换热,汽温特性趋近于纯对流式过热器。过热器中烟气的容积流量比燃煤时增大51.1%,受热面积相应减少36%。

(3) 高炉煤气高压锅炉经济器的吸热量比燃煤锅炉增加2.6倍,受热面积增加1倍。因此,高沸腾度经济器是高炉煤气高压锅炉的重要特点。高炉煤气和空气同时预热可以降低排烟温度,提高炉膛温度水平,促进稳定燃烧和强化辐射换热。

(4) 研制的首台50 MW全燃高炉煤气高压锅炉运行实践表明,该锅炉具有燃烧超低热值煤气和很宽的负荷调节能力,能够解决冶金企业高炉煤气排放污染问题,有着广阔的应用前景。

注:文中m^{3}为标准立方米

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alkali metallic oxides on the NO reduction, the authors have specially investigated the effect of bituminous coal char after its being subjected to an impregnated catalyst treatment on the NO reburning process and NO reduction rate. The test was completed at an initial concentration of NO at $1\,000\times10^{-6}$ and under reaction temperatures of 900 ℃ and 1 100 ℃ respectively. The test results indicate that the metallic oxides in the coal ash have a very strong catalytic action on NO in the reburning zone. The bituminous coal char originally believed to have a very poor effect on NO reduction can exercise a great influence on heterogeneous reduction of NO after a cheap catalyst being added to the above-mentioned coal char. Under the condition of an appropriate reaction temperature and stoichiometric ratio (SR) the catalyst in the coal char can reduce the activation energy of NO reduction reaction and expedite the speed of that reaction, thus quickening the NO reduction speed. **Key words**: reburning, coal char, NO catalytic reduction

中储式热风送粉 W 型火焰锅炉炉内空气动力场实验研究＝**Experimental Study of Aerodynamic Characteristics in a W-shaped Flame Boiler Equipped with a Bin and Feeder System and Fed Tertiary Hot Air in the Boiler Furnace** [刊, 汉] / YAN Xiao, XU Wei-jiang, SUN Xin-guo, HUI Shi-en, XU Tong-mo (Energy & Power Engineering Institute under the Xi'an Jiaotong University, Xi'an, China, Post Code: 710049) // Journal of Engineering for Thermal Energy & Power. —2001, 16(3). —263 ~ 266, 281

With regard to a W-shaped flame boiler imported from US Foster Wheeler Co. and fitted with dual-swirl separation type pulverized coal burners a cold model was set up based on an analog simulation. With the help of an hot-wire anemometer and by the use of a trace method measurements of in-furnace aerodynamic field were taken under different operating conditions. As a result, obtained under various operating conditions were the vector diagrams of in-furnace flow field, length of flame, curves of in-furnace main gas-flow distribution along the furnace depth direction and curves of variation of main gas-flow filling-fullness degree. On the basis of the experimental results an analysis was conducted of the in-furnace aerodynamic characteristics. The results of an experimental study indicate that the tertiary air fed into the furnace at high velocity along a horizontal direction has a significant effect on the in-furnace aerodynamic characteristics. **Key words**: W-shaped flame boiler, cold model experiment, aerodynamic field, dynamic flow rate

近临界及超临界压力区垂直光管和内螺纹管传热特性的试验研究＝**Experimental Investigation of Heat Transfer Characteristics of Vertical Smooth Tubes and Internally Ribbed Ones in Near-critical and Supercritical Pressure Zones** [刊, 汉] / HU Zhi-hong, CHEN Ting-kuan, SUN Dan (National Key Lab of Multi-phase Flows under the Xi'an Jiaotong University, Xi'an, China, Post Code: 710049) // Journal of Engineering for Thermal Energy & Power. —2001, 16(3). —267 ~ 270

Presented in this paper are the test results of the heat transfer characteristics of vertical smooth tubes and internally ribbed ones in near-critical and supercritical pressure zones. In the near-critical pressure zone the heat transfer characteristics of the smooth tubes will deteriorate when the pressure increases to approach the critical pressure. The critical dryness of heat transfer deterioration will experience a drastic reduction. In extreme cases there emerges a dramatic rise in wall temperature even in a sub-cooled zone. As for an internally ribbed tube, its heat transfer deterioration in the near-critical pressure zone can be eliminated. However, with the pressure approaching a critical one the capacity of the internally ribbed tube to suppress heat transfer deterioration will decrease. The minimum heat transfer factor of the smooth tube and internally ribbed tube after a heat transfer deterioration will occur respectively at a pressure of 21.0 MPa and 22.0 MPa. After surpassing the critical pressure the smooth tube and the internally ribbed one will have their respective heat transfer characteristics improved. In a high enthalpy zone the internally ribbed tube can experience a reduction in wall temperature. **Key words**: internally ribbed tube, heat transfer deterioration, near-critical pressure, supercritical pressure, supercritical pressure boiler

50 MW 高压锅炉全燃高炉煤气的研究＝**A Study of Blast Furnace Gas-fired 50 MW High-pressure Boiler** [刊, 汉] / ZHUANG Zheng-ning, CAO Zi-dong, TANG Gui-hua, SHEN Yue-fen (Thermal Energy Engineering Department, Xi'an Jiaotong University, Xi'an, China, Post Code: 710049) // Journal of Engineering for Thermal Energy & Power.

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A detailed discussion was conducted concerning a blast furnace gas-fired 50 MW high-pressure boiler. Expounded were the combustion technology, which can promote the stable ignition of a blast furnace gas-fired boiler, and the latter's structural design features. After an analysis of the influence of blast furnace gas firing on the boiler's thermodynamic parameters, heat transfer characteristics and heating surface layout the authors have proposed a layout scheme suitable for a blast furnace gas-fired boiler. The first blast furnace gas-fired 50 MW boiler in China has been manufactured based on the above study results. Its successful operation experience indicates that with the blast furnace gas firing-related pollution issues effectively resolved this type of boiler will enjoy broad prospects of application in metallurgical industries. **Key words**: blast furnace gas, high-pressure boiler, research, design, operation

汽轮机调节系统中存在摩擦与间隙的响应特征研究＝**A Study of Response Characteristics of a Steam Turbine Governing System in the Presence of Friction and Clearance** [刊, 汉] / DAI Yi-ping, DENG Ren-gang, SONG Xiao-wei (Turbomachinery Research Institute under the Xi'an Jiaotong University, Xi'an, China, Post Code: 710049), XIE Dan-mei (Wuhan University of Water Resources and Electric Power, Wuhan, China, Post Code: 430072) // Journal of Engineering for Thermal Energy & Power. －2001, 16(3). －275～277

Due to component wear, working oil-related pollution and ingress of foreign matter there may emerge cases of friction and an enlarged clearance in the governing system of a steam turbine. The foregoing can lead to a system limit-ring oscillation. When the friction resistance increased to a certain degree, seizure of moving parts may take place, posing a serious threat to the safety of the turbine unit. From the perspective of time-domain response and the analysis of frequency spectrum the authors have studied the response characteristics of the steam turbine governing system in the presence of friction and clearance. With the response characteristics of the friction and clearance being identified the present paper can serve some useful purpose for system status monitoring and failure diagnosis. **Key words**: steam turbine, governing system, nonlinear system, response characteristics

二次风量非均匀配比控制烟气偏差的理论分析及模型试验＝**Theoretical Analysis of Gas Deviation Control Based on Non-uniform Distribution of Secondary Air Flow and Its Related Model Testing** [刊, 汉] / ZHANG Xiao-ke, QIU Ji-hua (National Key Lab of Coal Combustion under the Huazhong University of Science & Technology, Wuhan, China, Post Code: 430074) // Journal of Engineering for Thermal Energy & Power. －2001, 16(3). －278～281

With regard to the common problem of gas deviation in a tangentially fired boiler this paper presents a new regulation approach from the perspective of engineering applications. Through an adjustment of the distribution of secondary air flow created is a local high-pressure and fuel-rich zone in the in-furnace gas flow. By squeezing and impacting on the flame main flow this zone can change the gas flow distribution at the furnace outlet, thus limiting the gas deviation. The feasibility of such a method has been validated from a theoretical analysis and checked by way of a cold model test. The results of study indicate that under this method of regulation the gas flow at the two sides of the horizontal flue duct can be balanced, resulting in a weakening of the residual swirl and a decrease in gas deviation. **Key words**: boiler, pulverized coal combustion, gas deviation, secondary air regulation, model test

燃气轮机装置中湿压缩过程的一般规律及性能＝**General Laws Governing Wet Compression Process in a Gas Turbine Plant and the Process Performance** [刊, 汉] / WANG Yong-qing, YAN Jia-lu, LIAN Le-ming (Harbin Institute of Technology, Harbin, China, Post Code: 150001), LIU Ming, He Jian-yun (Liaoning Provincial Energy General Co., Shenyang, China, Post Code: 110014) // Journal of Engineering for Thermal Energy & Power. －2001, 16(3). －282～286, 310

Based on the basic principles of thermodynamics as well as heat transfer and mass transfer the authors have studied the general laws governing wet compression process in a gas turbine unit and the process performance. This research work provides to a certain extent a theoretical basis for the implementation of the wet compression technology. **Key words**: gas