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超临界直流锅炉长期动态特性的建模与仿真

李运泽, 杨献勇
(清华大学 热能工程系, 北京 100084)

摘　要: 超临界直流锅炉长期动态特性对超临界直流锅炉汽轮机发电机组的仿真和控制系统设计具有十分重要的意义。为了快捷、全面、可靠地研究调峰及负荷变化过程中超临界直流锅炉的长期动态特性, 通过合理地机理分析和模型简化, 应用状态空间方法建立了超临界直流锅炉省煤器、水冷壁、过热器及再热器的简化数学模型, 推导出工质侧压力流量变化的一组更为简洁、新颖的非线性关系式。最后以上述简化状态空间模型和非线性关系式为工具对某 600 MW 超临界直流锅炉的长期动态特性进行了仿真研究, 仿真结果正确。本文的研究为超临界直流锅炉的长期动态特性研究提供了一个十分简便的数学模型和方法。

关　键　词: 超临界直流锅炉; 长期动态特性; 状态空间; 建模与仿真

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1　引　言

锅炉汽轮机组的长期动态特性(long term dynamics)在火电机组的仿真与控制系统研究中具有十分重要的地位[1~2]。文献[1~4]中对汽包锅炉的建模方法、模型简化及长期动态特性进行了大量的可贵探索, 文献[4~5]中给出了超临界直流锅炉一些可供参考的数学模型, 但上述模型或过于简单不够全面、或过于复杂不便应用。超临界直流锅炉长期动态特性研究迫切需要一种既形式简单、应用方便, 又内容全面、结果可靠的数学模型。

本文在总结前人研究的基础上, 通过合理的机理分析和模型简化, 建立了超临界直流锅炉机组的简化状态空间模型, 以及压力流量通道对应的非线性关系式。在此基础上以某 600 MW 超临界机组为例进行了仿真研究, 仿真结果合理、正确, 从而较为简便、全面地满足超临界直流锅炉长期动态特性研究的需要。

2　机理分析与简化

虽然超临界直流锅炉的动态过程包括几十甚至上百个快慢不一的储质及蓄热过程, 但整个机组的长期动态特性主要由变化比较缓慢的几个储质及蓄热过程所决定[1~5], 据此对机组的动态特性做如下分析和简化:

(1) 热水的密度变化十分微小而蒸汽的密度变化的时间常数很小, 因此近似认为热水的密度不变而蒸汽的密度变化可在瞬间完成。(2) 由于省煤器、过热器、再热器中工质与金属间换热十分剧烈, 故将各单相换热面中的工质热容与对应的金属壁热容合并, 且近似认为其工质出口温度与金属壁温的变化率相同。(3) 以水的临界密度作为超临界和亚临界压力下水冷壁建模中“热水段”与“蒸汽段”控制体间统一的划界标准, 则“热水段”与“蒸汽段”中工质密度的变化规律满足(1)中的分析与简化。为了分析方便定义“热水段”工质体积与整个水冷壁水容积之比为水冷壁的容积储水率。(4) 位于水冷壁中部的工质分界面温度是其压力的单值函数, 因为水冷壁中工质与金属壁间的换热十分剧烈、工质分界面温度与金属壁平均温度及整个水冷壁内的工质平均温度十分接近, 故近似认为三者变化率相等, 其变化快慢由工质分界面的压力变化所决定。(5) 近似认为省煤器的工质流动阻力集中在其入口, 水冷壁及过热器工质流动阻力全部集中在过热器出口。(6) 再热器的蒸汽压降远小于汽轮机压降可近似忽略, 汽轮机能量平衡信号(第 1 级后压力与机前压力之比)与调节阀开度成正比, 再热器压力与汽轮机第 1 级后压力成正比。(7) 由于烟气侧各动态过程的时间常数很小, 故近似认为烟气侧的流量、温度与放热量变化可在瞬间完成。由上述分析可得超临界直流锅炉长期动态特性模型的五个主要状态变量: 省煤器、过热器、再热器的金属壁温及水冷壁的容积储水率和工质分界面压力。

3　超临界直流锅炉的数学模型

3.1　单相受热面的动态方程

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作者简介: 李运泽(1972－), 男, 河北邢台人, 清华大学博士研究生.

根据上文分析与简化中的第(1)、(2)条可知省煤器、过热器、再热器各单相换热面平均金属温度的动态方程：

$$\frac{\mathrm{d}\theta_{mx}}{\mathrm{d}t}=\frac{Q_{gx}-g_{ox}(h_{ox}-h_{ix})-g_{swx}(h_{ix}-h_{swx})}{M_{mx}c_{mx}+M_{fx}c_{fx}} \quad (1)$$

式中：下标 $x\in\{e, s, r\}$ 代表省煤器、过热器、再热器各单相换热面；θ_{mx}、h_{ix}、h_{ox} 分别为单相换热面 x 对应的平均金属温度及进出口工质比焓；Q_{gx}、g_{ox} 分别为其对应的烟气放热量和工质的出口流量；g_{swx}、h_{swx} 分别为其引入的减温水总流量及其平均比焓(对于省煤器有 $g_{swx}=0$)；M_{mx}、c_{mx} 为换热面的金属质量和比热；M_{fx}、c_{fx} 为换热面内工质的质量和平均比热。

根据上文分析与简化中的第(2)条可知单相换热面 x 的出口工质温度：

$$\theta_{ox}=\theta_{mx}+\theta_{mox} \quad (2)$$

式中：θ_{ox}、θ_{mox} 分别为各单相受热面的工质出口温度和其与平均金属温度之差。

此时单相换热面 x 的出口工质比焓为：

$$h_{ox}=H(p_{ox}, \theta_{ox}) \quad (3)$$

式中：h_{ox}、p_{ox}、θ_{ox} 分别为单相换热面 x 出口的工质比焓、压力和温度；$H(p, \theta)$ 为水和水蒸气的物性方程。

3.2　水冷壁的动态方程

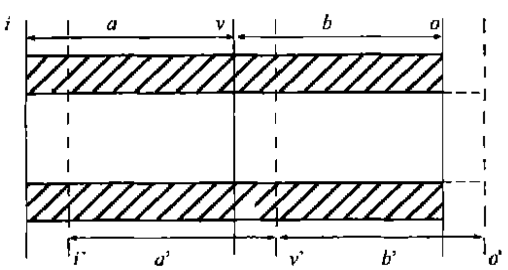

图 1　水冷壁中的与控制体划分与移动示意图

如图 1 所示，按上文分析与简化(3)中的划界标准将整个水冷壁分为热水段 a 和蒸汽段 b 两段，在任意时刻 t 取两个分别与当前时刻热水段 a 和蒸汽段 b 体积相等、位置相同的控制体 a 和 b，令其左右边界的移动速度均等于工质分界面 2 的移动速度，微元时间 $\mathrm{d}t$ 后控制体位置为图 1 虚线所示 a' 和 b'。

记水冷壁的容积储水率：

$$\Psi=\frac{V_a}{V_w} \quad (4)$$

式中：Ψ、V_a 分别为水冷壁的容积储水率和热水段工质体积；V_w 为水冷壁总的水容积。

则此时控制体 a 中的质量守恒方程为：

$$g_i-g_v-V_w(\rho_i-\rho_v)\frac{\mathrm{d}}{\mathrm{d}t}\Psi=V_a\frac{\mathrm{d}}{\mathrm{d}t}\rho_a \quad (5)$$

式中：g_i、g_v 分别为边界 i、v 的质量流量；ρ_i、ρ_v 分别为边界 i、v 的工质密度；ρ_a 为热水段的平均密度。

控制体 b 中的质量守恒方程为：

$$g_v-g_o-V_w(\rho_v-\rho_o)\frac{\mathrm{d}}{\mathrm{d}t}\Psi=V_b\frac{\mathrm{d}}{\mathrm{d}t}\rho_b \quad (6)$$

式中：V_b、ρ_b 分别为蒸汽段的工质体积和平均密度；g_o、ρ_o 为水冷壁的出口工质流量和密度。

由式(4) ~ 式(6)及上文分析与简化(3)可得水冷壁容积储水率的动态方程：

$$\frac{\mathrm{d}\Psi}{\mathrm{d}t}=\frac{g_i-g_o}{V_w(\rho_i-\rho_o)} \quad (7)$$

近似假定水冷壁热流密度沿管长方向分布均匀，控制体 a 中的能量守恒方程为：

$$\Psi Q_{mw}+g_ih_i-g_vh_v-V_w(\rho_ih_i-\rho_vh_v)\frac{\mathrm{d}}{\mathrm{d}t}\Psi$$
$$=V_a\frac{\mathrm{d}}{\mathrm{d}t}(\rho_ah_a) \quad (8)$$

式中：Q_{mw} 为水冷壁金属与工质间的总换热量；h_a、h_i、h_v 分别为热水段的平均比焓、水冷壁的进口比焓和工质分界面比焓。

控制体 b 中的能量守恒方程为：

$$(1-\Psi)Q_{mw}=g_vh_v-g_oh_o-V_w(\rho_vh_v-\rho_oh_o)\frac{\mathrm{d}}{\mathrm{d}t}\Psi$$
$$=V_b\frac{\mathrm{d}}{\mathrm{d}t}(\rho_bh_b) \quad (9)$$

式中：h_b、h_o 分别为蒸汽段的平均比焓和水冷壁的出口比焓。

水冷壁金属的能量守恒方程为：

$$Q_{gm}-Q_{mw}=M_{mw}c_{mw}\frac{\mathrm{d}\theta_{mw}}{\mathrm{d}t} \quad (10)$$

式中：Q_{gm} 为烟气对水冷壁金属的放热量；M_{mw}、c_{mw}、θ_{mw} 分别为水冷壁金属的质量、比热及温度。

由式(8) ~ 式(10)及上文分析与简化(3)、(4)可得水冷壁内压力变化的动态方程：

$$\frac{\mathrm{d}p_v}{\mathrm{d}t}=\frac{Q_{gm}+g_ih_i-g_oh_o-V_w(\rho_ih_i-\rho_oh_o)\frac{\mathrm{d}\Psi}{\mathrm{d}t}}{V_w\rho_a\Psi\frac{\mathrm{d}h_v}{\mathrm{d}p_v}+[M_{mw}+c_{mw}+V_w\rho_bc_b(1-\Psi)]\frac{\mathrm{d}\theta_v}{\mathrm{d}p_v}} \quad (11)$$

式中：p_v、t_v 分别为水冷壁工质分界面的压力和温度；c_b 为水冷壁中蒸汽段的平均比热。

此时水冷壁出口的工质比焓为：

$h_0=$

$$\frac{[Q_{\mathrm{gm}}-(M_{\mathrm{mw}}c_{\mathrm{mw}}+V_{\mathrm{w}}\rho_{\mathrm{b}}c_{\mathrm{b}})]\frac{\mathrm{d}\theta_v}{\mathrm{d}p_v}\frac{\mathrm{d}p_v}{\mathrm{d}t}(1-\Psi)+(g_i-V_{\mathrm{w}}\rho_i\frac{\mathrm{d}\Psi}{\mathrm{d}t})h_v}{g_{\mathrm{o}}-V_{\mathrm{w}}\rho_{\mathrm{o}}\frac{\mathrm{d}\Psi}{\mathrm{d}t}} \tag{12}$$

3.3　压力及流量通道的非线性关系式

根据上文分析与简化中第(1) 条可得省煤器其出口流量:

$$g_{\mathrm{oe}}=g_{i\mathrm{e}} \tag{13}$$

式中: g_{ix}、$g_{\mathrm{o}x}$ 分别为省煤器的进出口工质流量。

根据上文分析与简化中第(5) 条可得省煤器其进口压力:

$$p_{i\mathrm{e}}=p_v+z_{\mathrm{e}}\frac{g_{i\mathrm{e}}^2}{\rho_{i\mathrm{e}}} \tag{14}$$

式中: $p_{i\mathrm{e}}$、$\rho_{i\mathrm{e}}$ 分别为省煤器进口处的压力密度; p_v 为水冷壁的工质分界而压力; z_e 为省煤器阻力系数。

根据上文分析与简化中第(1)、(5) 条, 将水冷壁、过热器及新汽管道的阻力合并, 引用动量守恒方程和汽轮机新蒸汽的压力流量方程可得新蒸汽压力和流量分别为:

$$p_{0\mathrm{t}}=\frac{p_v}{1+z_{\mathrm{bt}}k_{\mathrm{t}}^2u^2} \tag{15}$$

$$g_{0\mathrm{t}}=k_{\mathrm{t}}u\sqrt{p_{0\mathrm{t}}\rho_{0\mathrm{t}}}=\frac{k_{\mathrm{t}}u}{\sqrt{1+z_{\mathrm{bt}}k_{\mathrm{t}}^2u^2}}\sqrt{p_v\rho_{0\mathrm{t}}} \tag{16}$$

上述两式中: $p_{0\mathrm{t}}$、$\rho_{0\mathrm{t}}$、$g_{0\mathrm{t}}$ 分别为机组新蒸汽的压力、密度和流量; z_{bt}、k_{t} 分别为锅炉的阻力系数和汽轮机的新蒸汽流量系数; u 为调节阀开度。

进一步可得水冷壁出口流量和过热器进口流量满足:

$$g_{\mathrm{o}}=g_{i\mathrm{s}}=g_{0\mathrm{t}}-g_{\mathrm{sws}} \tag{17}$$

根据上文分析与简化中的第 1、6 条可得再热器压力:

$$p_{\mathrm{r}}=k_{\mathrm{u}}k_{\mathrm{rt}}p_{0\mathrm{t}}u \tag{18}$$

式中系数: k_{u}、k_{rt} 分别为汽轮机能量平衡信号与调节阀开度之比、再热器压力与汽轮机第 1 级后压力之比。

再热器出口流量:

$$g_{\mathrm{or}}=g_{ir}+g_{\mathrm{swr}}=g_{0\mathrm{t}}-g_{\mathrm{rl}}+g_{\mathrm{swr}} \tag{19}$$

式中: g_{ir}、g_{or}、g_{swr} 分别为再热器的进出口流量和减温水流量; g_{rl} 为汽轮机在再热器进口前所有的抽漏汽流量之和, 其数值由汽轮机模型决定这里暂不介绍。

4　超临界直流锅炉的仿真研究

仿真实验表明: 应用本文建立的简化数学模型可以对超临界直流锅炉长期动态过程中单相换热面的金属及工质出口温度变化、水冷壁中的储质与蓄热变化、新蒸汽的压力与流量变化等进行全面地仿真研究, 模型简单、结果合理且编程容易。

这里仅以某 600 MW 超临界直流锅炉额定工况下燃料量发生 −10%的阶越扰动为例进行其长期动态特性研究作为仿真示例, 仿真过程中使用本文的锅炉模型及文献[3～5] 中的汽机模型, 并假定锅炉给水流量、给水焓不变, 减温水流量、减温水焓不变。主要仿真结果见图 2～图 7。

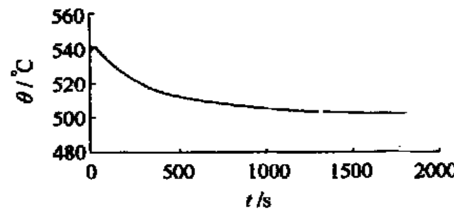

图 2　新蒸汽温度变化

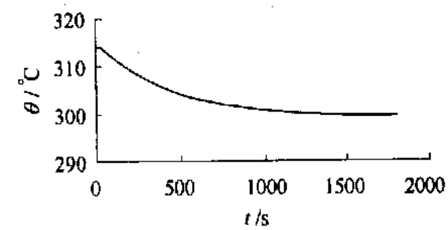

图 3　省煤器出口水温变化

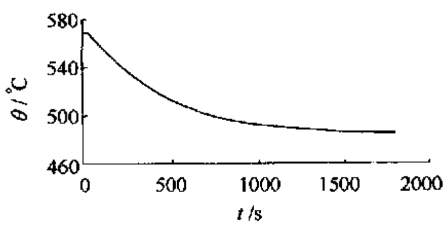

图 4　再热器出口汽温变化

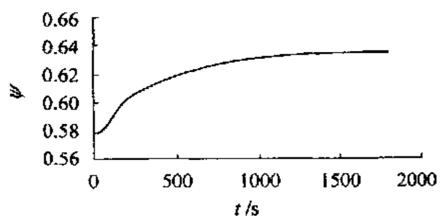

图 5　水冷壁容积含水率变化

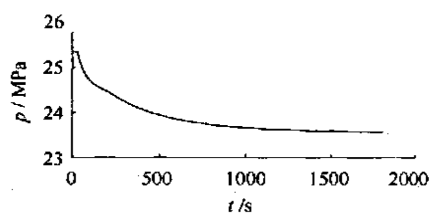

图 6　新蒸汽压力变化

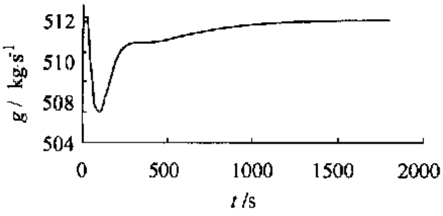

图 7　新蒸汽流量变化

额定工况下燃料量发生 -10% 的阶越扰动后，由于烟气放热量减少，新蒸汽温度、省煤器出口水温及再热器出口汽温逐渐降低至新的稳定值(图 2～图 4)，水冷壁容积储水率逐渐增加至新的稳定值(图 5)，新蒸汽压力逐渐降低至新稳定值(图 6)，新蒸汽流量先随新蒸汽压力下降一段时间后随新蒸汽温度下降而上升至其初始值(图 7)。上述仿真结果与文献[6] 中使用传统方法的仿真结果一致，而本文的模型更为简单。

5　结论

通过合理的机理分析和简化，建立了超临界直流以锅炉单相换热面壁温变化及水冷壁内储质与压力变化的动态方程，导出了工质侧压力流量变化的非线性关系式。上述的动态方程和非线性关系式同以往的数学模型相比具有主次分明、形式简单、内容全面、结果合理和适用范围大等重要特点，为超临界直流锅炉的长期动态特性乃至整个机组的仿真及控制系统研究提供一种十分新颖、简便、可靠的数学模型和研究方法。

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6　结论

通过本文的试验研究，可以得到以下结论：

(1) IFA300 恒温式热膜风速计和六线涡量探针及其采集系统能方便和精确地测量炉内的涡量场，从而可以认识炉内燃烧器区由于燃烧器相交射流形成的剪切涡。

(2) 由于燃烧器射流及上邻角燃烧器横向射流的干涉作用，在 4 号燃烧器射流的向火侧，形成了与横向射流之间的剪切大涡，剪切大涡做逆时针旋转，剪切大涡的涡量强度达到 $-3.25\times10^4 s^{-1}$。可以推测：在 1 号、2 号、3 号角燃烧器射流和各自的上邻角燃烧器射流的相交处，在燃烧器射流的向火侧，也会形成三个大的剪切涡，在炉内形成的四个大剪切涡是煤粉在炉内着火和燃烧的重要因素，对炉内的煤粉着火、燃烧起着主控作用。

(3) 按势涡、兰金复合涡二维轴对称涡和描述势涡涡量扩散的 Oseen 涡和泰勒(Tayler)涡的定义，炉内剪切大涡的旋涡模型服从 Rankine Vortex 的分布规律。

(4) 冷模试验中，炉内燃烧器区，燃烧器射流的向火侧，剪切大涡的涡核半径 r_0 为 25 mm，涡量 ω_z 为 -3.26×10^4 rad/s，按照兰金复合涡模型，炉内流体微团做刚体式旋转的角速度为 -1.56×10^5 r/min。对于 HG－2008/18.2－YM2 型锅炉原型，在半径约为 1 m 的涡核里，流体微团做刚体式旋转。

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(何静芳　编辑)

the method described above is highly effective in conducting the fuzzy quantitative treatment of fault sample modes of a regenerative heating device, dramatically improving the convergence of a neural network training and facilitating the fault diagnosis of the regenerative heating system. **Key words**: steam turbine unit, regenerative heating system, fault diagnosis, fuzzy treatment, radial base function network

电站锅炉蛇形管焊接接头加速寿命试验规范的研究＝**A Study of the Accelerated-life Test Specification for the Coil-tube Welded Joints of a Utility Boiler** [刊, 汉] / ZHAO Ji-jun, ZOU Jing-xiang (College of Astronautics under the Harbin Institute of Technology, Harbin, China, Post Code: 150001), XU Shi-bin (Harbin Boiler Co. Ltd., Harbin, China, Post Code: 150046)//Journal of Engineering for Thermal Energy &Power. — 2003, 18(1). —17～19

A test specification for the accelerated-life test of utility boiler coil-tube welded joints was developed for the study of the latter's reliability. On this basis high-temperature internal-pressure explosion endurance tests were conducted with regard to a huge amount of resistance welded 15CrMo and 12Cr1MoV steel tube joints. An analytical processing of the test results has demonstrated the consistency of the failure mechanism of the welded joints under various accelerated-life test conditions, testifying at the same time to the validity of the test specification. **Key words**: accelerated-life test, test specification, welded joint, reliability

大型电站锅炉燃烧器区向火侧剪切大涡的尺度及其旋转速度＝**Scale and Rotating Velocity of a Big Shear Vortex at the Fire-facing Side of a Burner Region in a Large-sized Utility Boiler** [刊, 汉] / DIAO Yong-fa, HE Bo-shu (National Key Laboratory of Coal Clean Combustion under the Tsinghua University, Beijing, China, Post Code: 100084), XU Jin-yuan (Energy and Power Engineering Institute under the Xi'an Jiaotong University, Xi'an, China, Post Code: 710049)//Journal of Engineering for Thermal Energy &Power. — 2003, 18(1). —20～22, 26

Measurements were taken of the vorticity field in the burner region of a HG-2008-YM2 type tangentially fired pulverized-coal boiler, which is considered as having a universal significance. The above measurements were conducted by employing a IFA300 constant-temperature hot wire anemometer with the use for the first time of a six-sensor hot-wire probe and its locating coordinate system. The big shear vortex at the fire-facing side of the tangentially fired burner jets is described by the use of a Rankine composite vortex. The scale and rotating velocity of the big shear vortex has been determined by a cold model test. The vortex core radius of the big shear is 25mm, and the rotating angular velocity of an in-furnace fluid tiny ball rotating as a rigid body, -1.56 x 105 r/min. The influence of the big shear vortex on pulverized-coal ignition and the NO_X nascent state in the relevant structure of the burner zone vortex was also analyzed. **Key words**: tangentially fired furnace, burner zone, big shear vortex, scale, rotating velocity, six-sensor hot-wire probe

超临界直流锅炉长期动态特性的建模与仿真＝**Modeling and Simulation of the Long-term Dynamic Characteristics of a Supercritical Once-through Boiler** [刊, 汉] / LI Yun-ze, YANG Xian-yong (Department of Thermal Energy Engineering, Tsinghua University, Beijing, China, Post Code: 100084)//Journal of Engineering for Thermal Energy & Power. — 2003, 18(1). —23～26

The long-term dynamic characteristics of a supercritical once-through boiler play a key role in the simulation and design of the control system of a supercritical once-through boiler and turbogenerator unit. To conduct a rapid, comprehensive and reliable study of the long-term dynamic characteristics of a supercritical once-through boiler in the process of peak-shaving and load changes, a simplified mathematical model has been set up for the economizer, water wall, superheater and reheater of a supercritical once-through boiler. The model building has been carried out on the basis of a rational mechanism analysis and model simplification and through the use of a state-space method. A group of fairly concise and innovative nonlinear relations for the pressure and flow rate changes at the working medium side have been derived. Finally, with the help of the above-mentioned simplified state-space model and nonlinear relations a simulation study was conducted of the long-term dynamic characteristics of a 600MW supercritical once-through boiler. The simulation results were found to be accurate. The present study has provided a very simplified and convenient mathematical model and method for the research of long-term dynamic characteristics of a supercritical once-through boiler. **Key words**: supercritical once-through boiler, long-term dynamic characteristics, state-space method, modeling and simulation

增压锅炉机组重要热工参数的选择＝**The Selection of Major Thermodynamic Parameters for a Supercharged Boiler Unit** [刊, 汉] / SHEN Zhi-gang, JIANG Ren-qiu (Harbin Engineering University, Harbin, China, Post Code: 150001), ZOU Ji-guo, CHEN Qi-duo (Harbin No.703 Research Institute, Harbin, China, Post Code: 150036) // Journal of Engineering for Thermal Energy & Power. — 2003, 18(1). —27～29

The major technical features of a marine supercharged boiler are described and, on this basis, the selection of important thermotechnical parameters is explored during the thermodynamic calculations of the boiler. This has laid a theoretical basis for the study of thermodynamic calculation techniques for a marine supercharged boiler unit. **Key words**: marine supercharged boiler unit, thermotechnical parameters, selection

煤粉炉中痕量元素迁移影响因素的研究＝**A Study on the Influencing Factors of Migration of Trace Elements in a Pulverized Coal-fired Boiler** [刊, 汉] / HUANG Ya-ji, JIN Bao-sheng, ZHONG Zhao-ping, et al (Key Laboratory of Education Ministry on Clean Coal Power Generation and Combustion Technology under the Southeastern University, Nanjing, China, Post Code: 210096) // Journal of Engineering for Thermal Energy & Power. — 2003, 18(1). —30～34

By using a Z-8200 atomic absorption spectrophotometer and a VF-320 X-ray fluorescent spectrograph the content of nine trace elements in raw coal, bottom slag and fly ash was measured quantitatively in a 220 t/h pulverized coal-fired boiler. On the basis of an improved relative enrichment factor of Meij and from the perspective of two aspects, namely, bottom slag and fly ash, a systematic analysis was performed of the influence of various factors on the law of migration. Such factors include: temperature, oxygen content, fly ash diameter, the properties of trace elements per se and the characteristics of coal rank. The results of the analysis indicate that an rise in furnace temperature can quicken the volatilization of some of the trace elements. The content of Cr and Mn in fly ash and bottom slag is comparable, but the two elements differ markedly in respect of relative enrichment factor. Low oxygen content does not always promote the volatilization of all trace elements. The content of Pb, Cd, Zn and Cr in the bottom slag and fly ash does not assume a linear relationship with their respective boiling points. The smaller the diameter of the fly ash, the greater the enrichment factor of the trace elements. The tendency of variation of various trace elements with the decrease in fly ash diameter has been found to be not identical for different trace elements. **Key words**: trace elements, relative enrichment factor, migration law, pulverized coal-fired boiler

燃煤排放正构烷烃类有机化合物的特征与形成演化机理研究＝**An Investigation on the Characteristics of the Discharge of Normal Paraffin Organic Compounds During a Coal-burning Process and Their Related Formation/evolution Mechanism** [刊, 汉] / LIU Hui-yong, SUN Zhi-kuan (Thermal Energy Engineering Department, Tsinghua University, Beijing, China, Post Code: 100084), SUN Jun-min, et al (Environment Protection Office under the Hunan Provincial Electric Power Co., Zhengzhou, China, Post Code: 450000) // Journal of Engineering for Thermal Energy & Power. — 2003, 18(1). —35～38

An analysis was conducted of the content distribution and characteristic changes of normal paraffin compounds discharged during the process of flue-gas temperature reduction at Yunnan Yangzonghai Power Plant, Guizhou Guiyang Power Plant and the Experimental Power Plant of Beijing Tsinghua University. The above-mentioned content distribution and characteristic changes identified during the analysis were compared with those in the aerosol sample taken at the flue duct leeward side. After an investigation the authors hold that the formation and evolution of the normal paraffin compounds during a coal-burning process represents an important formative stage of complicated organic pollutants. In addition, the mechanism of the change of molecular characteristics in the process of coal burning and flue gas temperature reduction constitutes a major distinguishing feature specific to a free radical polymerization and cracking. **Key words**: normal paraffin, formation and evolution