森源蓝天
SENYUAN LANTIAN

武汉森源蓝天环境科技工程有限公司

Wuhan Senyuan Lantian Environmental Technology Engineering Co.,Ltd.

中国 · 武汉

Wuhan China

Preface 序言

天空是炫丽的，高高的云层，绚丽的蔚蓝色
流动的彩云在空中随风翩翩起舞
彩云随着早、中、晚时间的变化
不断变换着颜色
时而金黄、时而洁白、时而像火一样红
我很少看见这么美的天空……
听着海浪拍打礁石的声音
感受着在蓝天自由奔跑的风的脚步
渐渐地我陶醉了
我仿佛看见了浪花在嬉戏
仿佛听见了海风在歌唱
此刻，我觉得世界竟然是那么的美妙
仿佛我也成了一朵浪花、一缕海风
在风中嬉闹，在浪中沉醉……

The brilliant blue sky is flowery with high clouds
Moving rosy clouds are dancing in the air with the wind
Rosy clouds change over morning, noon, and evening
Constantly changing with the color
Sometimes yellow, sometimes white, sometimes red like fire
I have rarely seen such a beautiful sky....
Listening to the sound of waves hitting the rocks
Feeling the free running steps under the blue sky
I am over whelmed by this scene slowly
I see the waves is playing
I hear the wind is singing
This moment,I feel the world is so wonderful
Seems like I become wave and wind
Playing in the wind and overwhelmed in the waves......

碧水蓝天，您的梦想，森源人的责任。

森源人竭诚为清洁环保、健康的世界而努力！

Clean water and blue sky is your dream and it is SenYuan people's duty to fulfill the dream. We will try our best for the green and the healthy world!

CONTENT 目录

■ 公司简介 / ABOUT US

武汉森源蓝天环境科技工程有限公司成立于2009年，座落于美丽的东湖之滨，隶属"中国光谷"武汉国家东湖高新技术开发区高新技术环保企业，是湖北省隐形冠军培育企业、湖北省"专精特新"小巨人企业、武汉市瞪羚企业、武汉市十大科技创新示范企业、武汉市3551人才计划、工信部两化融合论证体系企业。为全球环境污染治理提供协同解决方案，是具有技术研发、设计、成套设备制造、工程施工、调试运行、运维管理等综合能力的环保服务提供商；并生产冶金设备、污泥干化设备、输送设备等成套产品。

公司业务范围涵盖中小型热电联产、烟气综合治理、农村环境及废弃物综合治理、气力输送等EPC总包工程；具备专业设备制造、电气制造、智能控制等多项技术研发与生产制造。拥有环保专项设计乙级、环保总承包二级、机电施工三级、电力施工三级，通过国际ISO9001、ISO14001、ISO18001管理三证体系认证，技术水平居国内领先地位。公司已为全球超过180家钢铁、电力、水泥、造纸、化工、冶金、可再生清洁能源等企业烟气综合治理EPC工程及10余乡镇农村河道和污水治理工程。先后荣获专利48项，产品销售遍及中国三十四个省市自治区，出口伊朗、印度、泰国、越南等国家和地区。

公司秉承"制造洁净空间，关爱人类共同家园"之经营理念，奉行以质量为生命，以信誉为灵魂，以市场为导向，以生态环境承载力为基础，以遵循自然规律为准则，以绿色科技为动力，倡导环境文化和生态文明，努力构建经济、社会、环境协调发展的全新体系。

公司遵循"以人为本、开拓创新、科技兴企、绿色环保"的战略，聚集了一批高、中级环保科技专业人才加盟。近几年来，随着供给侧的改革的深入发展，公司加大力度不断加强自身的软硬件环境建设，充分发挥多年从事环境污染治理的优势，进一步扩大了和全国各大高校及设计研究院所的紧密合作，先后与中科院、武汉安全环保研究院、武汉大学、华中科技大学、武汉理工大学、中南电力设计院、中国有色研究院、北京钢铁设计研究总院、首钢设计院、鞍钢设计院等十多家国家重点科研院所建立了长期稳固的合作伙伴关系。为了顺应市场需求，公司引进日本、德国、美国等发达国家的先进技术，运用CAD/CAM/CAPP等开发手段进行技术创新和技术升级，全面提高了公司产品、装备、工艺及管理水平。公司本着高标准、高起点、严要求的发展理念，聘请了专业技术团队，为公司可持续发展奠定了夯实的基础。

"卓越的管理、卓越的服务"是公司追求可持续发展的基本准则与经营理念；

"以人为本，诚信经营，一切为用户服务"是我们企业的宗旨；

"让用户满意，让用户放心"是我们执着的追求和期盼。

公司将以实现资源节约型、环境友好型社会作为企业的发展宗旨和实践指南，并积极承担这一重要的社会责任，为建设好两型社会贡献自己的力量，实现人类与自然、人类与环境的可持续发展，共创环保、健康的美好世界。

Wuhan Senyuan Lantian Environmental Technology Engineering Co., Ltd ("SLETC"), was founded in 2009, located on the shore of the beautiful East Lake, is a high-tech environmental protection enterprise in Wuhan High-Tech Development Zone. SLETC has been named Wuhan Top 10 Scientific Innovation Demonstration Enterprise,small giant enterprise of "specialization and innovation" in Hubei Province， Wuhan Gazelle Company,Wuhan 3551 Talent Plan, Ministry of Industry and Information Technology integration demonstration system enterprise . SLETC provides integrative solutions for global environmental pollution. SLETC is a service supplier for environment protection with comprehensive capabilities in research and development, design, complete equipment, engineering construction, commissioning, operation and maintenance management. It also provides complete sets of products such as metallurgical equipment、 sludge drying equipment and transportation equipment.

SLETC may provide a number of technical support and services, such as EPC of small and medium-sized power stations, gas pollution treatment projects, rural river and sewage treatment projects for new countryside construction, pneumatic transmission projects, professional equipment manufacturing, electrical manufacturing, intelligent control, etc. Environmental protection special design class B, environmental protection general contracting class II, mechanical and electrical construction class III, power construction class III.At present, SLETC has passed the ISO9001, ISO14001, and ISO18001 international quality management system certifications, and its technical level ranks top in China. SLETC has provided high-quality whole sets of products and services for more than 180 enterprises in different industries like steel, power, cement, paper, chemical, metallurgy, renewable clean energy and our projects for clients also include more than 10 projects of rural river and sewage treatment in the world. SLETC has won 48 patents successively, Product sales throughout China 34 provinces and autonomous regions, and exported to Iran, Brazil, India, Thailand, Vietnam and other countries and regions.

SLETC adheres to the business philosophy of "making clean space and caring for the common home of mankind". SLETC keeps faith with the principle of taking quality as life, reputation as soul, market as guidance, and ecological environment bearing capacity as basis. SLETC follows natural law as principle and she takes green technology as power. Moreover, SLETC advocates environmental culture and ecological civilization and she strives to build a new system of coordinated economic, social and environmental development.

SLETC implements the strategy of "people-oriented, pioneering and innovative, science and technology enterprise, and green environmental protection", and has gathered a number of high-level and intermediate-level professionals in environmental protection technology filed. In recent years, through the in-depth development of supply-side reform, SLETC has continued to strengthen its own hardware and software environment construction. On the other hand, SLETC maximizes his advantages of many years' experience in environmental pollution control and he further expands close cooperation with major universities and design institutes across the country. SLETC have successively established long-term and stable partnerships with more than ten national key scientific research institutes like the Chinese Academy of Sciences, Wuhan Institute of Safety and Environmental Protection, Wuhan University, Huazhong University of Science and Technology, Wuhan University of Technology, Central South Electric Power Design Institute, China Nonferrous Metals Research Institute, Beijing Iron and Steel Design Research Institute, Hebei design institute of building materials, Shougang Design Institute, Baosteel Design Institute and Anshan Design Institute.

In order to satisfy the market's needs, SLETC introduced advanced technologies from many countries as Japan, Germany, and the United States, and SLETC used CAD/CAM/CAPP and other development methods for technological innovation and technological upgrade, which comprehensively improved our product, equipment, process and management levels. Based on the development concept of high standards, high starting points and strict requirements, SLETC has hired a professional technical team, which laid a solid foundation for the company's sustainable development.

"Excellent management & Excellent service'' is our basic principle and business philosophy for sustainable development.

"People oriented; Honest management; All for customers'' is the purpose of SLETC.

"Make customers satisfied & Make customers trust'' is our pursuit and wish.

SLETC will take the realization of resource-saving and environment-friendly society as the development goal and practice guide of the enterprise, and we will actively undertake this important social responsibility, and SLETC finally will contribute to the construction of resource saving society and environment-friendly society, realizing the sustainable development of human & nature & environment to create a healthy world of environmental protection and beauty together!

企业发展战略
DEVELOPMENT STRATEGY

聚焦环保产业，实行“以人为本、开拓创新、科技兴企、绿色环保”的战略，实施人力资源、研发创新、资本运作、信息化与品牌营销战略，建立高效顺畅的组织运营与管理体系。为客户提供高品质服务，最终成为本产业的综合服务商与领导者。

SLETC focuses on environmental production industry, execute the strategy of “People oriented, Innovation motivation, Science construction, Green environmental protection”. We implement the strategy for Human resource, R&D Innovation, Capital operation, Information and Brand marketing, and develop highly effective and smoothly organization operation and management system. SLETC will supply good quality service to customers and finally become the comprehensive server and guider in this industry.

企业愿景：绿色与生命共存，健康与财富共进

企业使命：携有志者，不断创新，努力营造人类宜居环境，
追求未来美好生活

企业精神：协同、创新、卓越

核心价值观：为客户创造价值、为员工创造机会
为社会创造财富、为生态创造平衡

企业口号：我努力，共发展，我自豪

服务理念：客户至上、品质第一、专业专注、服务高效

Corporate vision: green and life coexist, health and wealth advance together

Corporate mission: with those who have aspirations, constantly innovate, strive to create a livable environment for human beings and pursue a better life in the future

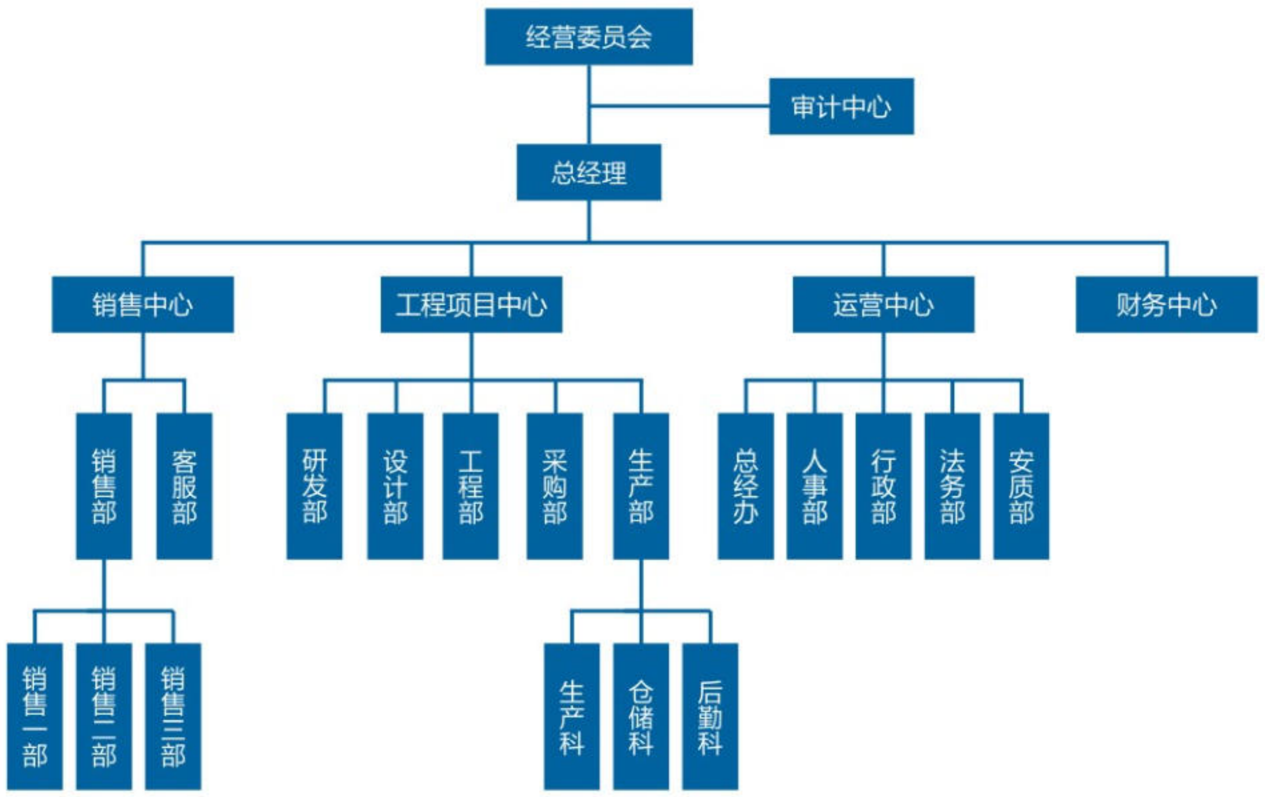
Spirit: Cooperation, Innovation, Outstanding

Core value: Create value for customer, opportunity for stuff
value for society,balance for ecology

Slogan: Effort, Development, Pride

Service Idea: Customer supreme, Quality first, Professional focus, effective service

公司组织架构图
ORG CHART



企业资质荣誉
HONOR OF ENTERPRISE QUALIFICATION

企业荣誉源于我们不懈的追求！
多年来我们艰苦奋斗、开拓创新，以“专业服务，诚信务实”
的服务理念，博得了国内外广大客户的信赖与支持，
在以后的征程中，我们将再接再厉共创辉煌。

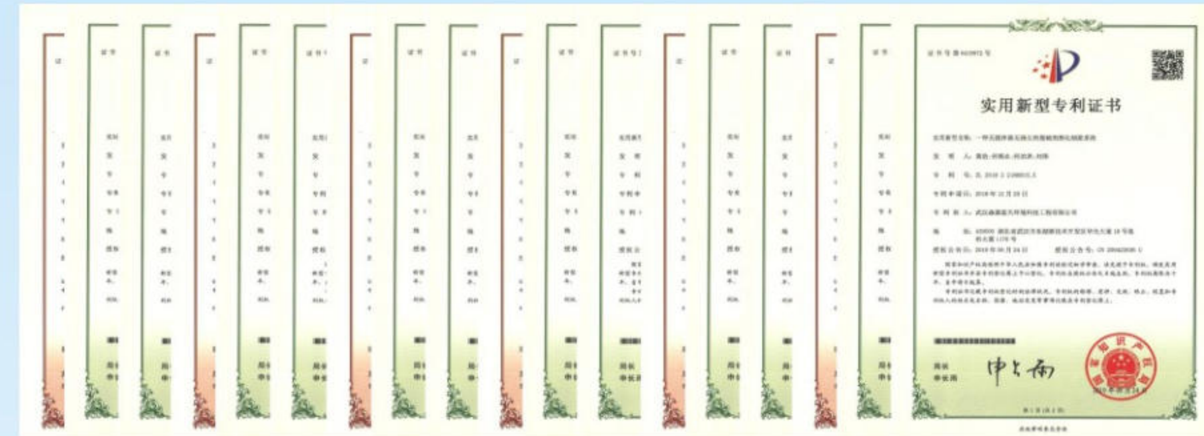
Company's honor depends on our insistent pursuit.
We have worked hard and diligently with innovation and we take
“professional service & integrity and pragmatic” as service ideas for
many years, which help us win the trust and support from customers
at home and abroad. We will continue to take effort to create glories.

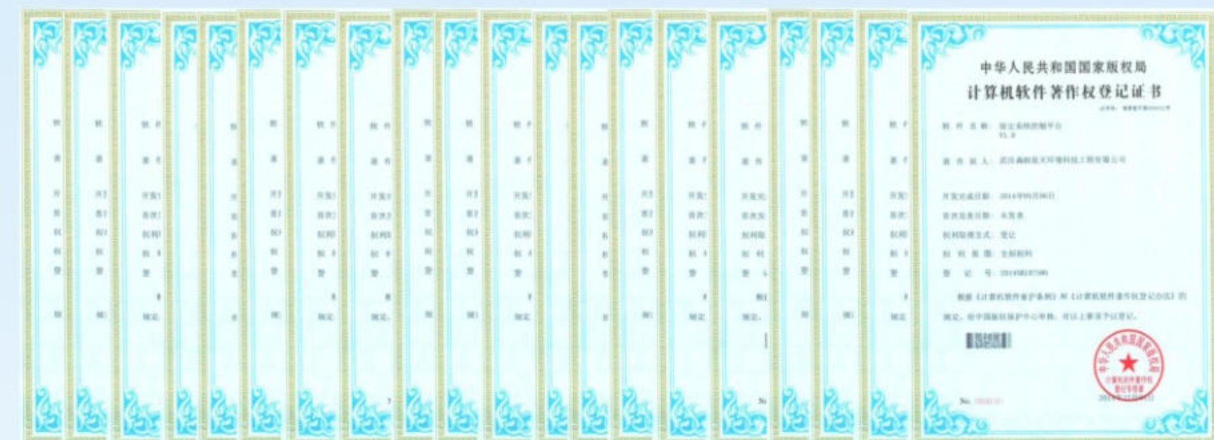
每一项荣誉都见证了我们的发展和壮大，都是对公司奋发努力辛勤耕耘的肯定。
每一项荣誉都是新的起点，我们将一如既往为创建环保、健康的美好世界而努力奋斗！

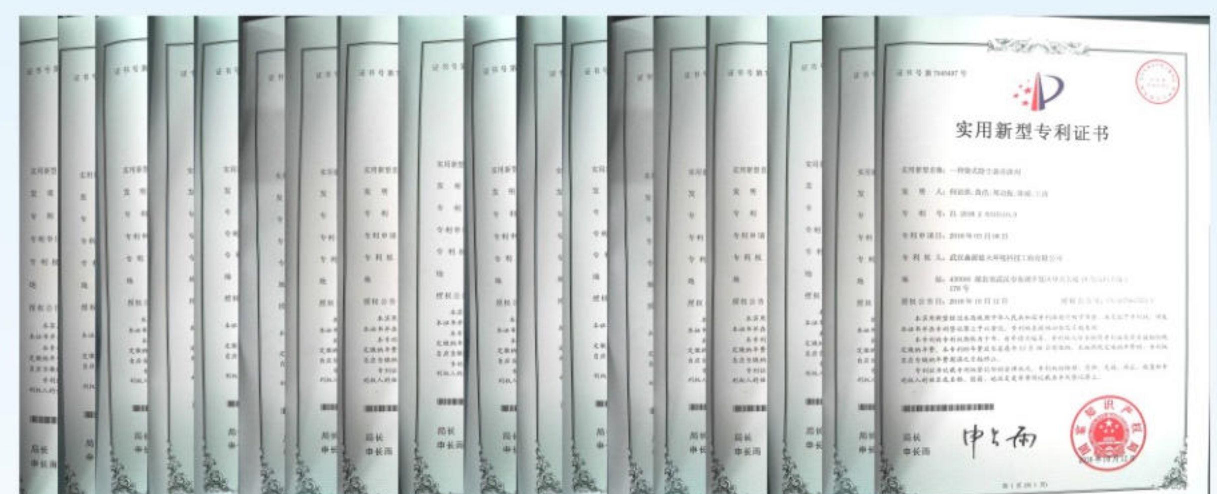
Each honor witnessed our development and growth and is recognition of our diligent work.
Each honor is a new start so that we will be always working hard to create an environmental-friendly and healthy world.

企业资质荣誉
HONOR OF ENTERPRISE QUALIFICATION

专利证书
PATENT CERTIFICATE







T■科技创新与研发
echnological innovation and R&D

公司遵循“以人为本、开拓创新、科技兴企、绿色环保”的战略，聚集了一批高、中级环保科技专业人才加盟。

公司始终把科技创新作为企业发展的核心动力，拥有独立的科学研发体系，拥有独立的科研机构。近几年来，公司不断加强自身的软硬件环境建设，充分发挥多年从事除尘设备生产经营的优势，进一步扩大了和全国各大设计研究院所的紧密合作。先后与多家国家重点科研院所建立了长期稳固的合作伙伴关系，为公司进一步发展壮大奠定夯实的基础。通过技术创新和技术升级，全面提高了公司产品、装备、工艺及管理水平。

通过引进、消化、吸收、创新，经过不懈的努力，完成了对产品的更新换代，质量改进和技术更新工作。

SLETC is based on the strategy of People-oriented, Innovation motivation, Science construction, Environmental protection, which gather a number of environment protection professionals.

SLETC always takes the science innovation as the core motivation of company development with independent R&D system and institute. Company has taken efforts to continuous self-strengthen on construction of software and hardware and fully used the advantages of many years engagement in production and operation of duct removal equipment, and given further expansion in closely cooperation with colleges and R&D institutes at recent years. SLETC developed stable cooperative relationship with major research institutes for a long time, which lay a solid foundation for further development. By innovating and updating in technology, we have comprehensively improved our production, equipment, techniques and management levels.

Through the combination of the introduction of advanced technologies with digestion and innovation, SLETC has completed the upgrading of products, quality improvement and technical updates.

Q■质量与安全控制
uality& safety control

客户的信心，源于我们对产品质量的不懈追求。

先进的检测设备和手段，为产品质量提供了坚实的科学保障。拥有一批经验丰富、专业知识强的质检人员和质量监督管理人员，为产品质量提供了强有力的知识保障。

公司按照ISO9001:2015国际化标准建立了完善的质量管理体系，通过持续的质量改进，不断满足顾客的需求。建立高于国标的内控质量标准，赋予了产品更高的安全系数。

生产过程中实行生产工人自检、QA检测的质量保证体系，确保产品在每一环节的质量均处于受控状态。

质量控制的同时，重视加强安全控制，公司制定了各级安全生产责任制，将安全生产责任制作为企业岗位责任制的一部分，是安全管理最根本的一项制度。

公司坚持“以人为本”的原则，加强公司生产工作的劳动保护、改善劳动条件，保护劳动者在生产过程中的安全和健康，通过了ISO14001和ISO18001体系认证，建立完善的安全保证体系。

健全各项安全管理制度和操作规程，坚持“三个同步，四不放过，五同时”原则，通过各级安全生产机构的建设，切实落实各项安全生产措施。

The faith of customer is sourced from our insistent pursuit for quality.

Advanced test equipment and methods provide strong scientific guarantees of the high quality. Moreover, a group of quality personnel and QC supervision personnel with experience and knowledge provide guarantees for high product quality.

SLETC established a perfect quality management system in accordance with the ISO9001:2015 international standard. And through continuous quality improvement, we continuously meet the needs of customers. The establishment of internal control quality standards which are higher than the national standard, which give the product a higher safety evaluation criterion.

During production process, the quality assurance system of the self inspection and QA testing ensure that the quality of the products of every process is in a controlled state.

Attention is paid to strengthening safety control, and also the quality control. SLETC has made the responsibility system for production safety at all levels. Taking the responsibility system for production safety as part of the post responsibility system of the enterprise is the most fundamental system for safety management.

SLETC adheres to the principle of “people first”, strengthens the labor protection of the company's production work, improves the working conditions, and protects the safety and health of workers in the production process. SLETC has got the ISO14001 and ISO18001 system certifications and established a perfect safety assurance system.

We will improve various safety management systems and operating procedures and adhere to the principle of “three-synchronizations, four-not-permit, and five at the same time”. Finally SLETC effectively implements various safety production measures through the construction of safety production workshops at all levels.

森源蓝天
SENYUAN LANTIAN

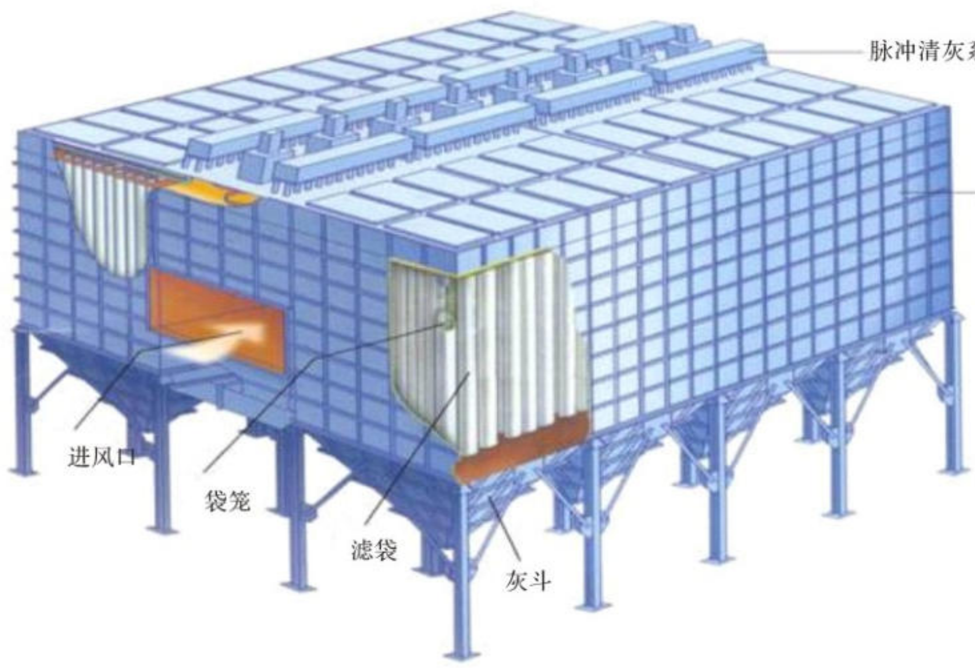
烟气除尘技术
FLUE GAS DUSTING TECHNOLOGY

■ 长袋低压脉冲喷吹袋式除尘器技术
Long bag low pressure pulse injection fabric filter

该系统是在常规短袋脉冲袋式除尘器与气箱脉冲袋式除尘器的基础上发展起来的，具有先进水平的高效袋式除尘设备。其具有处理风量大、清灰效果好、除尘效率高、运行可靠、维护方便、占地面积小等技术特点，已在钢铁、电力、化工、水泥、冶金等领域广泛使用。

Long bag low pressure injection fabric filter is a new, highly efficient fabric filter developed on the basis of conventional short bag pulse jet fabric filter and air box pulse jet fabric filter, combined with the advantages of chamber back blowing and pulse blowing, long filter bag and pulse jet blowing give full play to the role of strong compressed air blowing. The utility model has the technical characteristics of high efficiency, low energy consumption and less land occupation. This device has widely been used in steel, power, chemical, cement, metallurgy and other fields.

布袋除尘器结构图 Bag Filter Structure Chart



本体由以下部分组成：
The body consists of the following parts

本体、喷吹系统、导流系统、过滤系统、灰斗、排风系统、电控系统
Equipment body, pulse injection system, gas distribution system, filtration system, ash hopper, exhaust system, electric control system

布袋除尘器关键部件：
Key components of fabric filter


滤袋
Filter-bag


滤笼
Bag cage


上箱体
Upper box


脉冲阀
Pulse valve

滤袋 Filter bag

针对不同工况，选用不同材质的滤料，进行防水、防油、防酸(Cl、S)、防氧化处理，确保滤料使用寿命≥30000小时，粉尘排放可实现≤ 5 mg/Nm³。

Using felt filter material adapt to the working condition, waterproof, anti-oil, anti-acid(Cl、S), anti-oxidation treatment,to ensure the bag service life of the filter material lasts more than 30000 hours, dust emission guarantee less than 5 mg/Nm³.

滤笼 Bag cage

有足够的强度和刚度，反撑环的间距为180～200mm。整个袋笼焊接完成后，表面光滑、无毛刺。并进行防腐、防高温、有机硅浸渍、高温烘烤硅油处理。

The spacing of supporting ring is 180 ~200 mm with sufficient strength and rigidity.After the welding of the entire bag cage is completed. the surface is smooth with no burr. And anti-corrosion, high temperature resistance, silicone impregnation,high temperature baking with silicone oil will be proceeded.

脉冲阀和喷吹装置 Pulse valve and injection device

采用进口的淹没式的脉冲阀，包括意大利 TURBO、澳大利亚 GOYEN、美国ASCO等品牌，其清灰时间短、耗气量小。

Imported submerged pulse valves are adopted, including Italian TURBO, Australia GOYEN, the United States ASCO such other brands, with short cleaning time and low gas consumption.

技术创新：
Technological Innovation

● 导流技术：导流是布袋除尘的核心技术，结合我公司的设计理念，我们采取了一系列措施，促使烟气均匀分布到每条布袋上，在保证滤袋承受负荷均匀而延长滤袋使用寿命的同时，最大程度上降低设备阻力。

● 进气方式与气流分布技术：我公司自主研发的进气均布技术，有以下特点：等量送风的进出气流通道，疏导气流，流向预定空间，气流流动顺畅、平缓；流程短，局部阻力小。

● 上箱体模块化技术：保证喷吹管与花板的袋孔能够严格对中，从而保证清灰效果和保护滤袋。上箱体在厂内加工制作，与喷吹装置组对安装后整体出厂。

● 固定管喷清灰技术：a.喷吹管在模具上定位开孔并制作出喷嘴；b.喷吹管与花板在工厂里定位组装并严格检验，确保不同心度<1mm；c.出厂前对喷吹装置逐个检验；d.花板与喷吹装置整体出厂、运输和安装。

● 低压喷吹技术：考虑到生物质循环流化床燃烧所产生的烟尘特点，设备阻力将快速增加，清灰频次将因此而加快，采用高压喷吹对滤袋使用寿命将带来不利影响，且附着在滤袋上的粉尘层会被完全冲散，不仅不利于粉尘借助自身重力降落到灰斗中，而且还容易造成粉尘的二次吸附。

● 等量送风技术：等量送风的进出气流通道，疏导气流，流向预定空间，以确保烟气进气方式合理，保证各单台除尘器烟气均匀；中箱体口内设置挡板，防止入口气流对滤袋的直接冲刷，使烟气均匀地流过布袋，同时有大颗粒粉尘预分离功能。

● Gas distribution technology: The core of the technology is gas distribution combined with our company design philosophy, We have taken a series of measures to promote flue gas evenly distributed on each bag, in the evenness of filter bag under load and prolonging the service life of the filter bag at the same time,reduce the pressure drop of equipment to the largest extent.

● Gas inlet type and gas distribution technology: SLETC independently developed the uniform air inlet technology, which has the following characteristics: even gas supply in and out of the air flow channel; gas guidance; gas flow to target space; smooth gas flow; short distance to flow; low local pressure drop.

● Upper box modular technology: To ensure that the spray pipe and bag holes of perforated plate can achieve strict alignment to ensure effective cleaning and protection of filter bag. Upper box will be processed in our factory together with blowing device. And after installation they will be sent as a whole group.

● Fixed tube spray ash cleaning technology:(a)Spray tube on the mold positioning hole and making the nozzle;(b)Spray tube with perforated plate is positioned assembly in the factory and strict inspection is conducted to ensure the eccentric spacing is less than 1mm;(c)Check injection device one by one before delivery; (d)Perforated plate and blowing device will be packed as a set during transportation and installation.

● Low pressure pulse injection technology: high pulse pressure injection will bring adverse effect on the service life of filter bag, and dust layer sticky to the filter bag will be completely break up,which are not only conducive for dust with the aid of its own gravity to land into the hopper, but also easy to cause second dust adsorption.

● The same amount of gas supply technology: The amount of air in and out of the gas flow channel; gas flow guidance; gas flow to target space in order to ensure reasonable flue gas inlet and the evenness of each single precipitator; Baffles are installed in the middle box to prevent inlet gas flow scour directly on the bag so that the flue gas flow may evenly go through the filter bag,while large particles of dust will get pre-separation capabilities.

森源蓝天 SENYUAN LANTIAN

■ 高净气室长袋低压脉冲喷吹除尘技术

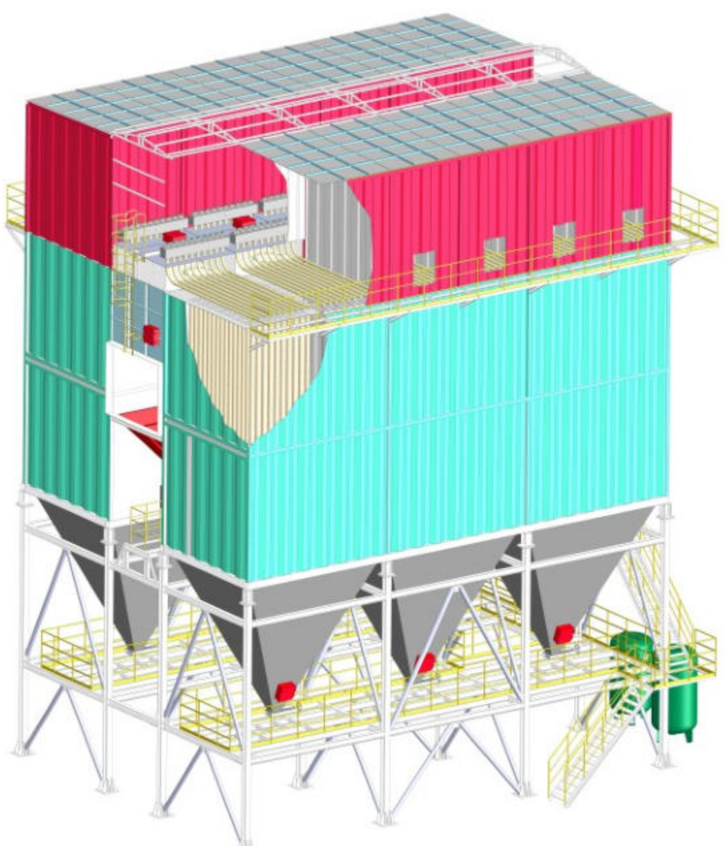
Long bag low-pressure pulse injection fabric filter with high gas cleaning chamber

针对生物质燃料特性，森源为彻底解决袋除尘器壳体腐蚀问题投入大量精力，历经三年开发了高净气室布袋除尘器，经过三代的技术升级已经趋于完美，经实际的生产运行验证，基本消除了这个生物质行业的难题，并根据5mg/Nm³超净排放需要，在结构上针对性地增加一些滤袋长期稳定运行措施，从而形成了目前森源成熟的高净气室超净布袋技术产品，并已获得国家专利授权保护。

According to the characteristics of biomass fuel, SLETC has invested a lot of energy to completely solve the corrosion problem of bag filter shell. After three years of development, the bag filter with high clean air chamber has become perfect after three generations of technology upgrading. After the actual production and operation verification, the problem of this biomass industry has been basically solved. And according to the need of 5mg / Nm³ ultra low dust emission, we targetedly add some long-term stable operation measures for structure of filter bags, forming the mature SLETC product of bag filter with high clean gas chamber and ultra low dust emission, which have obtained the national patent protection.

高净气室袋式除尘器结构图

Structure Chart



技术创新：

Technological Innovation

● 高净气室结构：在结构上改变净气室结构，目前的净气室检修门面积仅有传统的3%，根治漏风弊病，从源头上消除结露腐蚀问题。

● 双层密封门：针对净气室的检修小门，也采用了申请专利的双层防漏风耐腐蚀保温门，进一步减少漏风的可能。

● 顶部保温设计：结构改变后，整个净气室区域能实现顶部保温全覆盖，加强整体保温性能，配合高净气室和双层密封门结构，杜绝了净气室顶部的冷凝腐蚀问题。

● 先进的CFD数模：采用CFD模拟实验，优化系统进气方式改进，内部设置均流风墙，防止冲刷滤袋，降低系统运行阻力，调整滤袋均匀受风能力，提高系统设备整体效率。

● 占地面积小，节省投资：高净气室除尘器相对常规低净气室可以减少占地面积20%以上，显著提高了除尘器的布袋容积率，综合效益显著。

● 系统阻力较低，节能效果显著：高净气室除尘器气流走向特性产生的阻力显著降低，系统漏风也远低于低净气室，系统阻力和风量下降，减小引风机的运行负荷，长期运行节电效果明显。

● Structure of high clean gas chamber:The structure of clean gas chamber is changed. The area of access door of clean gas chamber is only 3% of the traditional one. This eliminate the problem of air leakage and condensation corrosion.

● Double layer sealing door:This is for the small maintenance door of the air purification room. And the patented double layer door with anti leakage & anti-corrosion abilty and heat insultaion is also used to further reduce the possibility of air leakage.

● Top insulation design:After the structure is changed, the entire gas cleaning chamber area can achieve full coverage of the top insulation, which may enhance the overall insulation performance, and cooperate with the high gas cleaning chamber and the double-layer sealed door structure to solve the condensation corrosion problem on the top of the air purification chamber.

● Advanced CFD model:CFD simulation experiment is used to optimize the gas inlet method for the system. The internal gas flow wall is set to prevent the filter bag from being washed, reducing the system operation resistance, adjusting the filter bag's uniform gas capacity, and improving the overall efficiency of the system equipment.

● Need less land and less investment:Compared with the conventional chamber, the high gas cleaning chamber can reduce the land area by more than 20%, which significantly improves the bag volume ratio of the bag filter. And the comprehensive benefits are significant.

● The system resistance is low, and the energy saving effect is significant:the resistance generated by the gas flow characteristics of the bag filter with high gas cleaning chamber is significantly reduced, and the system air leakage is also much lower than that of the traditional chamber. The system resistance and air volume are reduced, reducing the operating load of the induced draft fan. The effect of power saving during operation is obvious.

■ 袋式除尘器–旋转低压脉冲喷吹袋式除尘器

Frbric filter-Rotating low pressure pluse jet frbric filter

旋转低压脉冲袋式除尘器，有别于传统行喷吹脉冲袋式除尘器，是我公司结合国内外回转脉冲袋式除尘技术的基础上，自主研发的一种高效袋式除尘器。

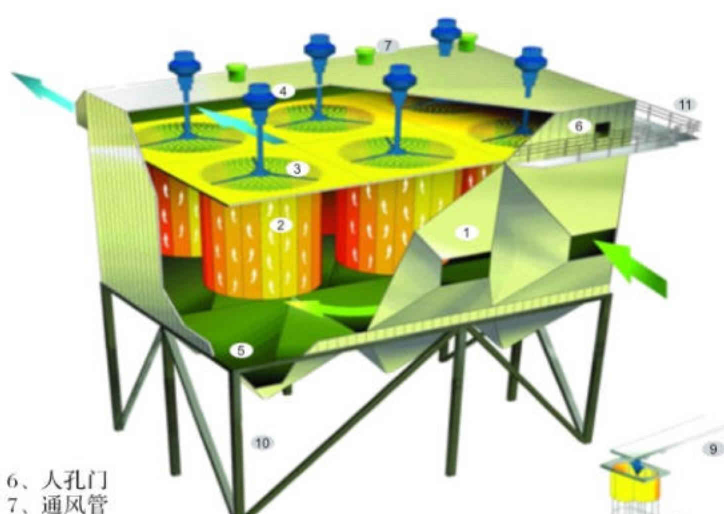
旋转低压脉冲袋式除尘器是将罗茨风机提供的低压压缩空气通过喷吹旋转臂喷入滤袋，达到清灰的目的。具有结构简单、清灰压力低、滤袋使用寿命长、操作维护方便、除尘效率高等特点。该除尘器不仅广泛应用于电站的燃煤锅炉烟气除尘与净化，还广泛应用于冶金、化工、建材等领域的烟气除尘与净化。

The rotary low-pressure pulse bag filter is different from the traditional line-jet pulse bag filter. It is a high-efficiency bag filter independently developed by our company based on the combination of domestic and foreign rotary pulse bag dust removal technology.

Rotating low-pressure pulse bag filter is to spray low-pressure compressed air provided by Roots blower into the filter bag through the spray rotating arm to achieve the purpose of dust removal. It has the characteristics of simple structure, low cleaning pressure, long service life of the filter bag, convenient operation and maintenance, and high dust removal efficiency. The dust collector is not only widely used in dust removal and purification of coal-fired boiler flue gas in power stations, but also widely used in dust removal and purification of flue gas in metallurgy, chemical, building materials and other fields.

旋转喷吹脉冲除尘器结构图

ROTATING INJECTION PULSE DUST COLLECTOR STRUCTURE CHART



1、进口烟箱
2、滤袋
3、花板
4、隔膜阀
驱动电机
5、灰斗
6、人孔门
7、通风管
8、袋笼
9、清灰臂
10、支架
11、平台楼梯

本体由以下部分组成：

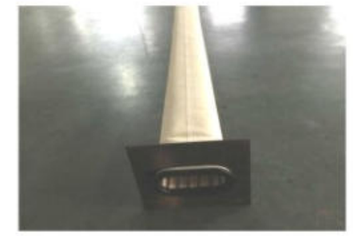
The body consists of the following parts

进口烟箱、滤袋、花板、隔膜阀、驱动电机、灰斗、人孔门、通风管、滤笼、清灰管、支架、平台楼梯

Import smoke box,filter bag,tube nest,diaphragm valve,drive motor,ash bucket,door,vent pipe,filter cage,Pipe cleaning,frame,platform stair

关键部件：

Critical component



扁袋
Flat bag

滤笼
Filtering groove

花板及喷吹臂
Tube nest and Blowing arm

大口径脉冲
Large diameter pulse

扁袋：旋转喷吹与行喷吹的花板结构不同，旋转喷吹的滤袋和袋笼口为椭圆形，因此采用椭圆形的扁袋，呈同心圆由内向外逐层辐射布置，过滤面积可增加20%～30%。

Flat bag: rotating injection and injection tube neststructure is different, rotating injection of filter bag and bag cage mouth is oval, so use the oval flat bag, in concentric circles from inside to outside radiation layout step by step, filter area can be increased by 20%～30%

旋转臂：可以用手自由转动，可将布袋、袋笼方便的取出和装入，旋转喷吹除尘器有更好的布袋检修空间。

Rotating arm: can rotate freely by hand , make a bag and bag cage convenient removal and loading, make rotating blowing dust collector have better bag maintenance space

大口径脉冲阀：旋转喷吹袋式除尘器采用大口径脉冲阀，每只脉冲阀喷吹可以多达上千条滤袋，数量少，不易损坏，若脉冲阀故障位置更容易排除。

Large diameter pulse valve: Rotary injection pulse dust collectoruse large-diameter injection pulse valve, every pulse valve injection can be up to thousands of filter bags, a small number, not easy to damaged, if the pulse valve fault location easier to exclude

技术创新：

Technological Innovation

- 采用低压脉冲清灰，延长布袋寿命20%-40%。
- Using Low-pressure pulse cleaning dust, extend the life of the bag to 20% -40%

旋转喷吹 → 0.06～0.085MPa
长袋低压 → 0.2～0.5MPa

- 采用大口径脉冲阀，数量少、控制点少，易于判断脉冲阀故障位置、易更换滤袋
- Using large diameter pulse valve ,a small number ,less control points ,easy to determine the fault location pulse valve, easy to replace the filter bag

旋转喷吹 → 12～16寸
长袋低压 → 2～3寸

- 采用扁袋，本体圆形结构，节省占地面积
- Using the flat bag ,body circular structure, saving footprint

扁袋
圆形结构
→ 空间利用率大、节省占地空间

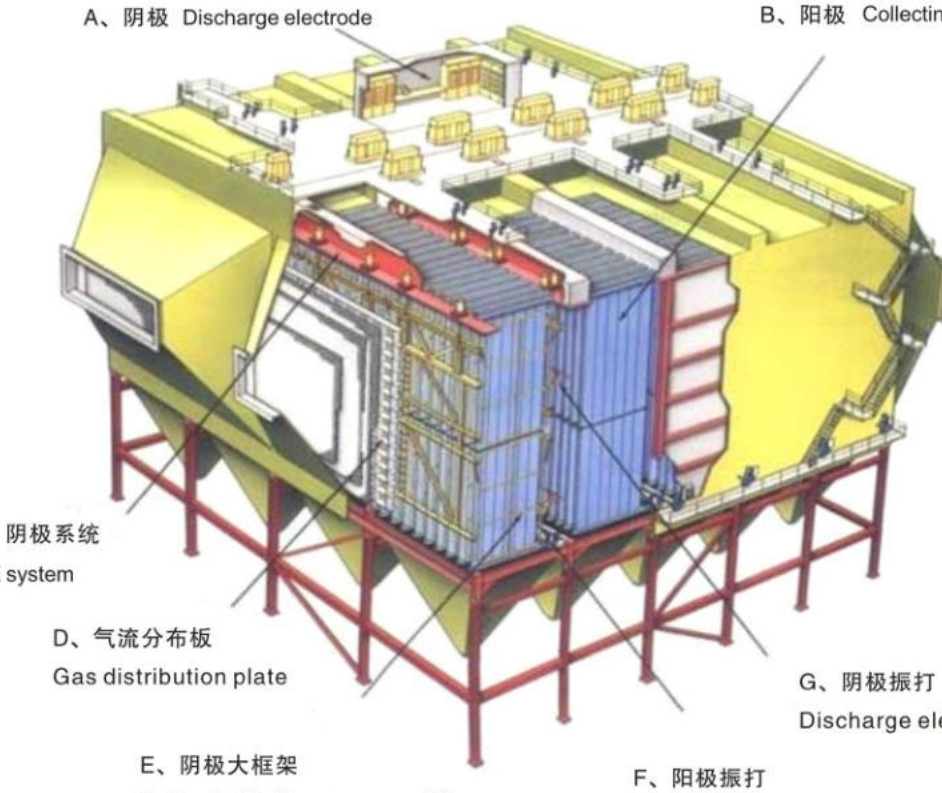
森源蓝天
SENYUAN LANTIAN

■ 高温电除尘器技术
High temperature ESP technology

高温环境下的含尘气体，由于粉尘粘滞力、比电阻和低温环境均有较大变化，细颗粒凝聚能力降低，所以对微粒的分离有较高难度。此外，高温时采用的设备材质、结构形式以及热膨胀等工程问题往往影响设备的正常有效运行。相对常规电除尘有如下几个特点：1、电除尘器在高温情况下长时间运行，会存在粉尘性质的变化问题，即随着温度的升高，气体黏度会相应增加，除尘效率会随之降低。甚至还可能出现低比电阻粉尘的跳跃现象。2、在高温条件下，高温静电除尘器的一些部件，虽然其承受的应力远远小于工作温度下的屈服强度，但是在长期使用过程中，会产生缓慢连续的塑性变形，材质能承受的应力值降低。3、高温静电除尘器在高温烟气环境中，受烟气中的灰分作用，会发生不同程度的高温氧化、硫酸盐腐蚀、硫化腐蚀等高温腐蚀。4、在长期高温运行条件下，高温电除尘器的绝缘材料的体积电阻率会随温度的升高而降低，直至失去绝特性，存在安全隐患。我公司自主研发的高温电除尘器规避上述问题，已在众多工程项目中得到了成功的应用。

Under the high temperature environment, due to the great fluctuations of dust viscosity, specific resistance and low temperature environment, the agglomeration ability of fine particles is reduced. So it is difficult to separate the particles. In addition, the engineering problems such as material, structure and thermal expansion of the equipment used in high temperature often affect the normal and effective operation of the equipment. Compared with the conventional electrostatic precipitator, it has the following characteristics: 1. When the electrostatic precipitator operates for a long time under high temperature, there will be the change of the dust properties. That is, with the increase of temperature, the gas viscosity will increase correspondingly, and the dust removal efficiency will decrease accordingly. Even the jump phenomenon of dust with low specific resistance may occur. 2. Under high temperature condition, although the stress of some parts of the high temperature electrostatic precipitator is far less than the yield strength under the working temperature, in the long-term use process, there will be slow and continuous plastic deformation, and the stress value that the material can bear will be reduced. 3. For high temperature electrostatic precipitator in the high temperature flue gas environment, due to the ash in the flue gas, different degrees of high temperature oxidation, sulfate corrosion, sulfide corrosion and other high temperature corrosion. 4. Under the condition of long-term high-temperature operation, the volume resistivity of the insulating material of the high-temperature electrostatic precipitator will decrease with the increase of temperature. And finally it will lose the insulation ability, resulting in a potential safety risk. The high temperature electrostatic precipitator developed by our company can avoid the above problems and has been successfully applied in many projects.

高温电除尘器结构图
High temperature ESP structure



本体由以下部分组成：
The body consists of the following parts

烟气进出口系统、壳体、阴极系统、阳极系统、灰斗系统、楼梯平台、高压电源装置和低压控制系统

Flue gas inlet and outlet system, casing, DE system, CE system, ash hopper system, stair platform, hot air purging system, high voltage power supply device and low voltage control system

除尘器关键部件：
Key components of dust collector:


阳极板
Collection Electrode


阴极线
Discharge Electrode


控制柜
Control cabinet


高频电源
High-frequency power

技术创新：
Technological Innovation

●**阳极板**：采用耐高温热变形好的C480极板，其表面有多道压型槽，两侧有较宽的防风沟，极板整体的刚度较高，选用耐高温变形及抗振打性能都较好的SPCC材料，在高温环境下形变很小。

●**阴极线**：采用新型BS整体管状线，抗拉强度高，保证直线度好且不断线，高温烟气下工作时不变形。该线起晕电压低，放电均匀，电流密度大，与C480极板极配效果很高。

●**结构设计**：电除尘器属于体积比较大的设备，高温环境下的热膨胀变形更大，采用摩擦力小的支座吸收壳体变形，壁板采用耐高温腐蚀、高温应力性能好的材料。阴极系统采用分段式框架悬挂，减少变形累积效应，振打轴联接处采用弹性膨胀结构。

●**热风吹扫系统**：高温环境下的绝缘子吹扫不能使用低温烟气，否则很容易造成绝缘瓷件性能下降，甚至破损，设计的热风压力大于除尘器运行内压，且高出露点20度以上。

●**高温绝缘瓷件**：常规绝缘材料的体积电阻率随温度升高而降低，会严重影响电场的绝缘性能，采用高温性能稳定的特殊绝缘材质制作瓷瓶和绝缘子。

●**气流均布**：采用导流、阻流组合型气流分布板，气流均布好，系统阻力小。电场末尾加装迷宫型槽形板，加强均布效果，进一步提高收尘效率。

●**高频电源**：电源特性优良，反应速度快于70ns，体积小、重量轻、节约场地。

●**低压控制**：采用小区供电，提高运行电晕功率，降低系统故障率，配合控制系统采用降压振打技术，最大效率发挥电控设备性能。

●Collection plates: the CE plates adopt the anti-high-temperature and anti-distortion C480 plate, and its surface has multiple pressure grooves. And both sides have wide wind grooves. The overall rigidity of the plates is high. SPCC material with good anti-high-temperature and vibration resistance is selected, and the deformation is very small in high temperature environment.

●Discharge Electrode: new BS integral tube is adopted, with high tensile strength, good straightness and no broken line, and no deformation when working under high temperature flue gas. The corona voltage of the line is low, the discharge is uniform, the current density is large, and the matching effect with C480 electrode is very high.

●Structure design: the electric precipitator belongs to the equipment with large volume, and the thermal expansion deformation is larger under high temperature environment. The support with small friction is used to absorb the shell deformation, and the wall plate is made of materials with high temperature corrosion resistance and high temperature stress performance. The discharge electrode system is suspended by segmented frame to reduce the cumulative effect of deformation, and the joint of vibrating shaft is of elastic expansion structure.

● Hot air purging system: it is not allowed to use low-temperature flue gas for insulator purging under high-temperature environment, otherwise it is easy to cause performance degradation or even damage of insulating ceramic parts. The designed hot air pressure is greater than the internal pressure of fabric filter operation, and more than 20 degrees higher than the dew point.

●High temperature insulating porcelain parts: the volume resistivity of conventional insulating materials decreases with the increase of temperature, which will seriously affect the insulation performance of the electric field. Special insulating materials with stable high temperature performance are used to make porcelain bottles and insulators.

●Gas flow distribution: the combined air flow distribution plate of diversion and damper is adopted, with good air flow uniform distribution and small system resistance. At the end of the electric field, labyrinth groove plate is added to enhance the effect of uniform distribution and further improve the efficiency of dust collection.

●High frequency power supply: it has excellent power supply characteristics with faster response speed than 70ns, small volume, light weight and land saving.

●Low voltage control: the power supply of bus section is used, improving the power of operation corona, reducing the failure rate of the system. Cooperating with the control system to use the voltage reduction rapping technology, the efficiency of the electronic control equipment performance will be maximized.

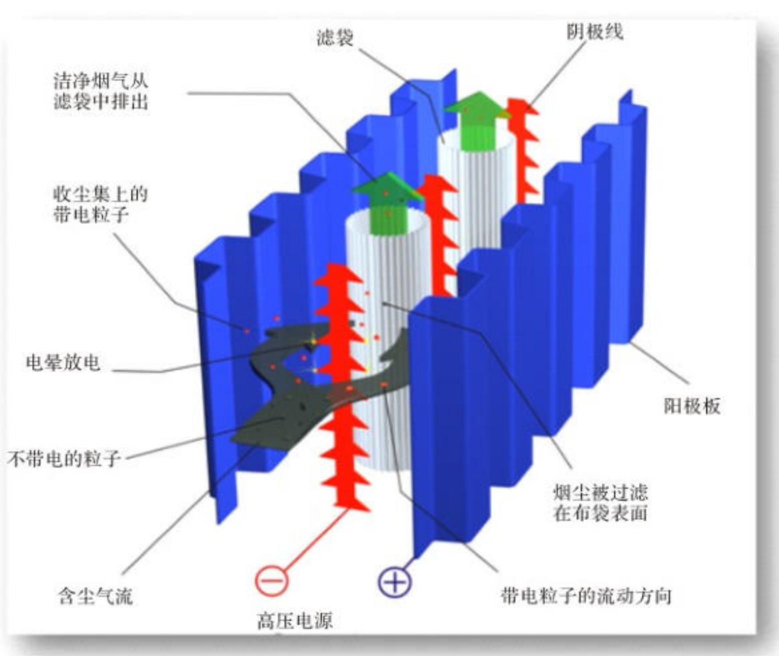
■ 嵌入式电袋复合除尘技术
Embedded Electrostatic Fabric Filter

嵌入式电袋复合除尘器是一种独特的电袋复合除尘器，有别于在传统的前电、后袋复合除尘器，是将静电部分（放电极和收尘极）和滤袋交替排列布置，即嵌入混合式电袋除尘器。在收尘机理上，通过荷电粉尘使布袋的过滤特性发生变化，产生新的过滤机理，利用荷电粉尘的气溶胶效应，提高滤袋过滤效率。含尘烟气先通过电收尘区，烟气携带的大部分颗粒在到达滤袋之前被吸附在阳极板上，初步净化了烟气，之后通过收尘板的孔隙流向滤袋，通过过滤作用进一步净化烟气。在滤袋清灰时，电收尘区可有效地捕集滤袋清灰时的二次反扬尘，大大降低粉尘再次被夹带到滤袋上的可能性。收尘板位于滤袋的两侧，确保电晕放电过程中电火花不至危及滤袋。是今后发展前景十分远大的新型除尘装置。

Electrostatic Fabric Filter is a new ESP (discharge electrode and a collecting electrode) and a bag filter arranged alternately arranged, namely embedded hybrid electric bag filter. The dust collecting mechanism is as follow: the filter characteristic of the dust bag is changed by the charged dust changed. Because of aerosol effect of charged dust, dust collecting efficiency of bag filter is improved. First when flue gas goes through ESP region, most of the particles carried in the flue gas is collected to CE plates before reaching the bag. After ESP preliminary purification, flue gas goes to filter bag. Through the leaks of CE plates, flue gas further purification. When the bag discharge the ash, ESP may effectively trap secondary dust emitted from the bag, greatly reducing the possibility of dust entrained again on the bag. Collecting plates located on both sides of the bag, ensuring that the corona discharge process not to harm the spark bag. Electrostatic Fabric Filter is a very promising new technology for dust removal.

嵌入式电袋复合除尘器结构图

Structure Chart of Embedded Electrostatic Fabric Filter



本体由以下部分组成：
The body consists of the following components

净气室、顶棚、滤室内导流板、滤袋、灰斗、排风、烟气进出口系统、壳体、阴极系统、阳极系统、楼梯平台、高压电源装置和低压控制系统

Gas cleaning chamber, pent house, guide plates in filter house, filter bag, ash hopper, exhaust, flue gas import and export system, casing, collection electrode ,discharge electrode ,stair platform, high voltage power supply devices and low voltage control system

电袋复合除尘器关键部件：
Key components of Electrostatic Fabric Filter


花板及喷吹管
Perforated plates and nozzle pipe


脉冲阀
Pulse valve


控制柜
Control cabinet


阴极电磁振打装置
Magnetic rapper of DE

技术创新：
Technological Innovation

- 设备体积小、占地面积小、投资少（即设备可省收尘板面积、过滤面积、截面积、占地面积20～30%）；
- 除尘效率高（可以控制在5mg/Nm³以下）；
- 整台设备阻力小（800pa以下）；
- 运行维护费用低（比同类除尘器少40%左右）。

- Small equipment cubage, small land occupation, less investment (the device can reduce collection plate area, filter area, the cross-sectional area, land area by 20 to 30%);
- High efficiency of dust collection (outlet dust concentration can be controlled under 5 mg/Nm³);
- The whole device pressure drop is small (low more than 800 pa);
- Low operation and maintenance costs (about 40% less than comparable filter).

■湿式电除尘器技术
Wet ESP technology

湿式电除尘器设备是由阴极线和阳极管（沉淀极）组成的，其工作原理为烟气通过高压电场，高压电场使烟气中的烟尘和雾滴带电，形成带电离子，带电离子向相反电荷的电极运动，带电离子到达电极后进行放电，形成中性尘、雾颗粒，沉积于电极上凝集、降落而被除去。

为了提高湿式电除尘器的除尘、除雾效率，必须形成一定强度的电场，这就要求在湿式电除尘器阳极管内必须具备大于起晕电压和起晕电流，同时阴极线上必须具备一定的线电流强度。

尘、雾的粒径大小和导电性能也是决定除尘、雾效率的重要因素，湿式电除尘器除尘、雾的主要粒径范围为0.01~100um之间，烟尘烟雾的比电阻范围为3×10^{6}~4×10^{10}欧姆厘米。

为了保证湿式电除尘器设备除尘除雾效率，必须定期对电除尘器阴极沉淀极用水进行清洗。

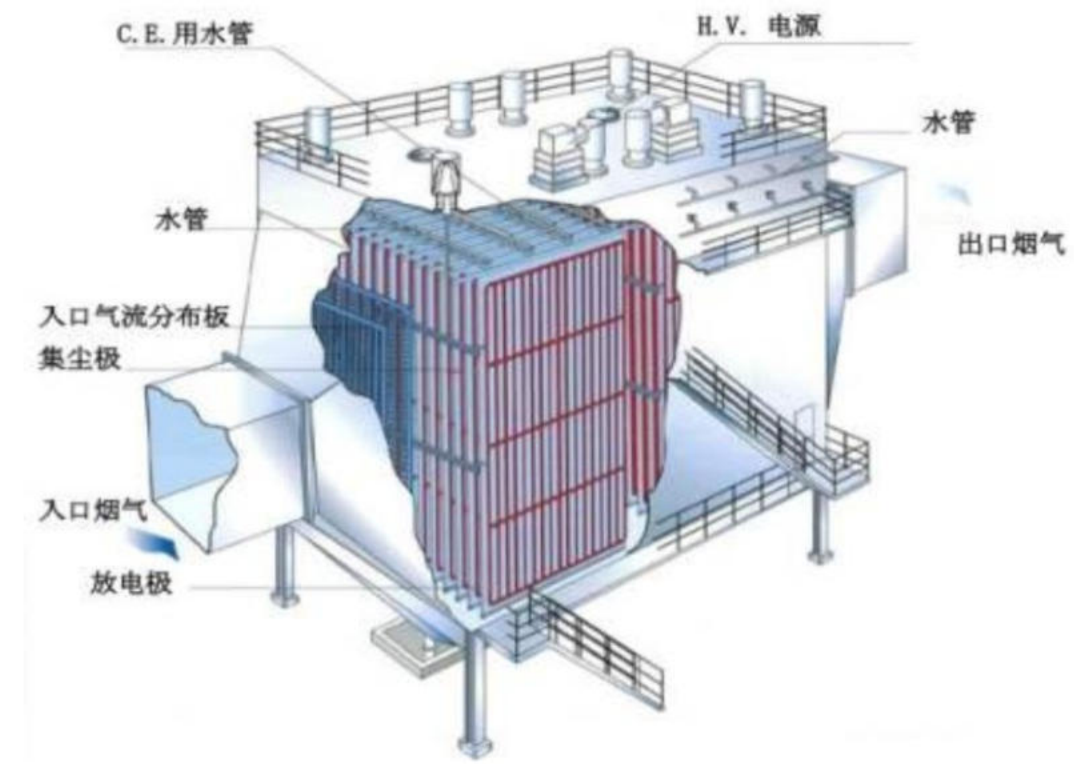
WESP device consists of a DE wire and a CE tube (precipitation electrode). Its working principle is as follow: the flue gas goes through high voltage electric field, high voltage electric field makes the droplets and particles of flue gas charged, forming charged ions. Charged ions move to the opposite electrodes. After charged ions reach the electrode and they will have discharge, forming neutral dust and mist particles which will deposit and aggregate on the electrodes, and finally be removed.

In order to improve the dust collection and demisting efficiency of WESP, certain strength of the electric field should be formed. And it requires CE tube must have voltage that is bigger than the inception voltage and current that is bigger than inception current in the WESP, while the DE wire must have a certain line current intensity.

Particle size and conductivity of dust and fog is an important factor influencing the efficiency of dust and mist collection. Major particle size of dust and fog for WESP range from 0.01 to 100um, and resistance range from 3×10^{6} to 4×10^{10} $\Omega\cdot$cm.

In order to ensure the collection efficiency of WESP, CE must be washed with water regularly.

湿式电除尘器结构图
Structure Chart of WESP



设备本体由以下部分组成：
Equipment body consists of the following components

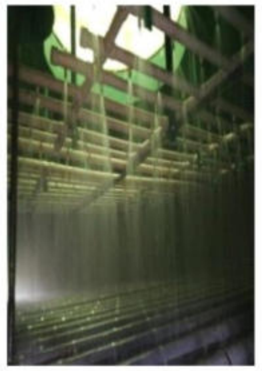
箱体及下部均流装置；集尘管组；放电极上、下吊架；电晕极；绝缘子箱及阴极固定器；间断喷淋系统；外部检修平台

Case box and bottom flow rectifier devices, CE tube group, up and low hanger of DE, corona Electrode, insulator box and DE holder, intermittent spray system, external maintenance platform

关键部件：
Critical component

刚性针刺线
Rigid prick line

集尘极组
Collecting electrode group



内部喷淋系统
Internal spray system

复合脉冲电源
Compound pulse power

● 刚性针刺线：耐酸腐蚀，完全满足脱硫后烟气环境，起晕电压低，比电流密度高，除尘效率高，刚性连接。

● 集尘极组：采用公司专利技术生产的导电玻璃钢，为CFRP导电碳纤维强化复合材料，由玻璃纤维、碳纤维、树脂材料和各种添加通过模压、缠绕、手糊成型，防紫外线处理等工艺制成。

● 内部喷淋系统：喷淋系统由分配管网和喷嘴组成，喷淋系统能均匀分布要求的喷淋量，流经每个喷淋层的流量相等，并确保循环液与烟气充分接触。

● 复合脉冲电源：最高技术参数：脉冲输出电压范围0~90KV，脉冲输出电流范围：0~6800mA。

● Rigid Prick: it is anti-acid and anti-corrosion, which fully meet the flue gas desulfurization environment. And it has low corona inception voltage, high electric current density and high efficiency for dust removal with rigid connection.

● Collecting Electrode Group: it adopts company's patented conductive glass steel, which is made of reinforced composite material for CFRP conductive carbon fiber. Reinforced composite material is made by crafts of glass fiber, carbon fiber, resin materials and various additives by molding, winding, manual lay-up, UV treatment etc.

● Internal Spray System: the spray system consists of distribution network and nozzles. The fluid can be evenly distributed with required spraying volume and amount of fluid through each spray layer remain same which may ensure that the circulation fluid with a good contact with flue gas.

● Compound Pulse Power: the highest technical parameters is as follow: Pulse output voltage range of 0 ~ 90KV. Pulse output current range: 0 ~ 6800 mA.

技术创新：
Technological Innovation

● 采用新型的耐腐蚀复合材料作为收尘极板，模块化结构、蜂窝布置，能有效利用空间、流场分布均匀。耐腐蚀，放电强力稳定，使设备电压、电流处于较高的参数，从而保证较好的除尘效果。

● 采用新型耐腐蚀复合材料使电除尘（雾）器结构布置灵活，能够适应目前复杂的改造场地，可单独布置于脱硫塔出口净气烟道处，也可布置于脱硫塔塔顶，或者单独布置于电厂场地条件允许的空地。

● 运行时不需要连续喷入碱性水，依靠电场区收集烟气中雾滴，在收尘管束内形成溢流，达到自流清灰的目的。

● 自主研发的复合脉冲电源采用恒流源和高效火花控制装置，能够有效避免闪落拉弧现象，保证电场稳定运行。（基础电压+脉冲电压=80KV+70KV=150KV，高达150KV的工作电压，真正能对高阻比大于10^{12}欧姆厘米灰尘进行高效荷电的电源；功率因数高COS$\varphi\geq0.98$，在相同效率下，节电30-70%。）

● 湿式电除尘器是当前最先进的PM2.5控制技术之一，能达到如下性能指标：满足排放5mg/m^3以下的要求。

● The new corrosion-resistant composite material is used as the collecting plate. Modular structure and honeycomb arrangement will lead to efficient use of space and help the even distribution of the flow field. The corrosion-resistant ability with strong and stable discharge makes the device at higher parameters of voltage and current, thus ensuring a better dust removal effect.

● Use new type of anti-corrosion composite material to make the electric (fog) structure arrangement of ESP flexible, which is able to adapt to the complex retrofit field. It can be separately arranged on outlet duct of flue gas desulfurization tower, and it also can be located in the top of desulfurization tower, while it can be arranged on the open space of power plant site if site condition permits.

● During operation it does not need continuous injection of alkaline water and electric field may help collect droplets in flue gas, forming an overflow in the collecting tubes, to achieve the purpose of ash removal.

● SLETC independently developed compound pulse power supply with high efficiency constant current source and spark control device, which can effectively avoid the flash off arcing, ensuring the stable operation of the electric field. Base voltage + pulse voltage = 80KV + 70KV = 150KV, 150KV high operating voltage is absolutely capable of efficiently charging dust particles of high resistance that are more than $10^{12}\ \Omega\cdot$cm; High power factor COSφ is more than 0.98. With the same efficiency, energy saving may reach 30-70%.

● WESP is one of the most advanced PM2.5 control technology. The technology can achieve the following performance metrics: meet the requirement of outlet dust concentration to be less than 5mg/m^3.

烟气脱硫技术
FLUE GAS DESULFURIZATION TECHNOLOGY

■干法/半干法烟气脱硫工艺
Dry / semi-dry flue gas desulfurization process

一、化学原理Chemical principle

$Ca(OH)_2+SO_2 \rightarrow CaSO_3 \cdot 1/2H_2O+1/2H_2O$

$Ca(OH)_2+SO_3+H_2O \rightarrow CaSO_4 \cdot 2H_2O$

$Ca(OH)_2+2HCl \rightarrow CaCl_2+2H_2O$

吸收塔内反应：Reaction in Absorber tower

$Ca(OH)_2+SO_2 \rightarrow CaSO_3+H_2O$

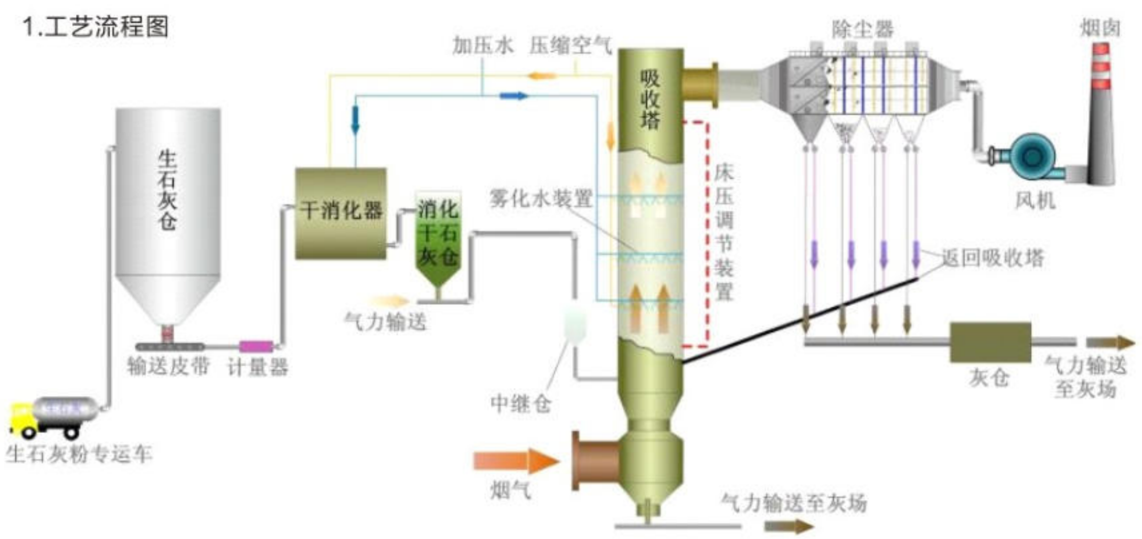
$Ca(OH)_2+SO_3 \rightarrow CaSO_4+H_2O$

$Ca(OH)_2+2HCl \rightarrow CaCl_2+2H_2O$

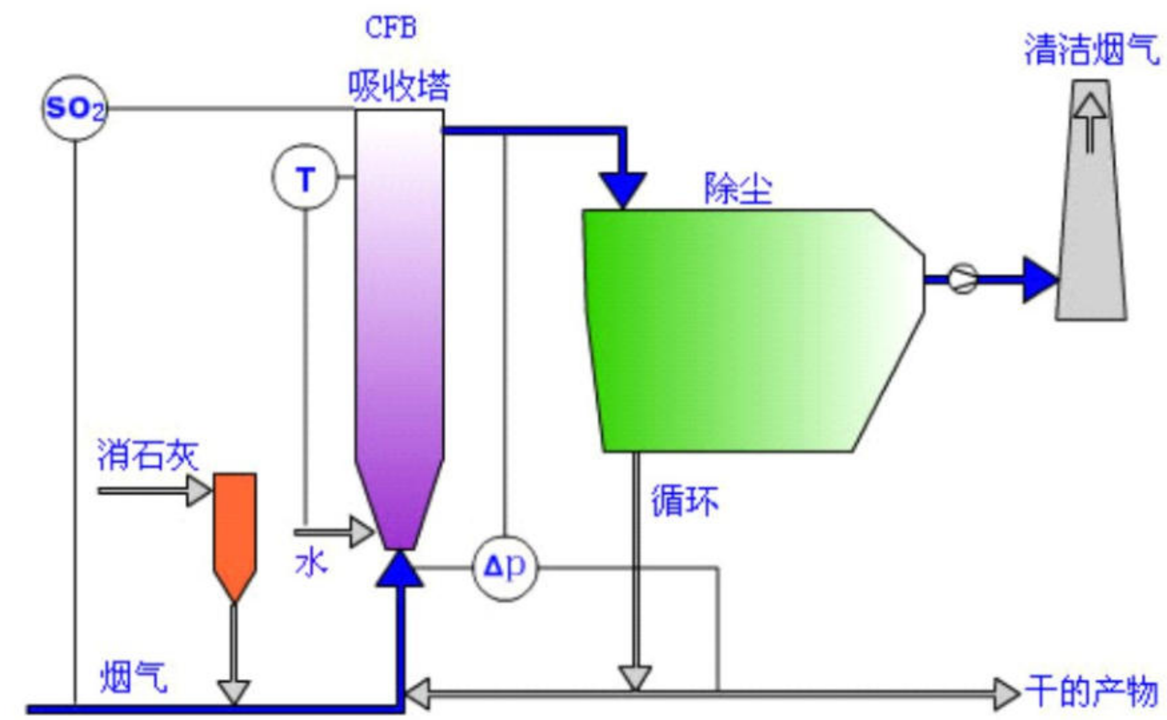
$Ca(OH)_2+2HF \rightarrow CaF_2+2H_2O$

二、工艺流程图Process flow Diagram

1.工艺流程图



2.工艺流程图



三、工艺原理介绍Process principles Introduction

从锅炉出来的含尘和SO_2的烟气，从脱硫塔的底部经过文丘里管上升，进入塔内。生石灰（CaO）在消化器内加水消化后，在消石灰仓内储存。将一定量的消石灰和水在文丘里喉口上端加入，在脱硫塔内与烟气混合流动，并与烟气中的SO_2反应，生成亚硫酸钙，进入后部的电除尘器或布袋除尘器。反应产物和煤灰被除尘器收下后，通过空气斜槽返回塔内，再次循环参与脱硫反应时间，消石灰的作用得以充分发挥，用量减少，同时脱硫效率得以提高。

Flue gas with dust and SO_2 from boiler passes from the bottom of the desulfurization tower and rise through the venturi-pipe and go into the tower. Quicklime (CaO) water will react with water to be hydrated lime in the digester and the lime will be stored in the lime storage bin. The lime and water will be injected to the upper end of the venturi throat to join in the flue gas desulfurization tower, mixing with flue gas, reacting with SO_2 in the flue gas, producing $CaSO_3$. Then the reaction products go into the latter ESP or bag filter. After the reaction product of coal ash and dust are received by ESP, some of them return through the air chute tower, and they once again participate in the desulfurization reaction cycle. So lime will be fully used and the consumption of lime is reduced, and the desulfurization efficiency can be improved.

四、系统组成 System Components

● 烟道系统：烟道、回风烟道、烟气挡板门及密封装置等设备；

● 吸收塔系统：带有文丘里喷嘴的空塔结构，加水增湿降温后的烟气与消石灰粉末完成SO_2和SO_3的吸收；

● 除尘器系统：过量的脱硫产物和消石灰粉混合物随烟气一起排出，进入除尘系统被捕集；

● 脱硫灰循环系统：脱硫反应产物被除尘器收集后，一部分通过空气斜槽返回塔内，再次循环；

● 吸收剂供应系统：由石灰粉仓及附属输送系统组成；

● 工艺水系统：一方面在消化器内使生石灰消化，另一方面通过高效雾化喷嘴对烟气进行降温和增湿。

● Flue duct system: gas duct, bypass gas duct, flue damper and sealing devices and other equipment;

● Absorption tower system: the structure of empty tower with venturi nozzle, the absorption of SO_2 and SO_3 after flue gas mixing with slaked lime powder after humidification with water and cooling;

● Dusting system: the mixture of excessive desulfurization products and slaked lime powder is discharged together with the flue gas and enters the dusting system for collection;

● Desulfurization ash circulating system: after the desulfurization reaction products are collected by the dust precipitator, some of them return to the tower through the air chute and circulate again;

● Absorbent supply system: it is composed of lime powder bin and auxiliary conveying system;

● Process water system: on the one hand, the quicklime is digested in the digester; on the other hand, the flue gas is cooled and humidified by high-efficiency atomizing nozzle.

五、技术创新Technological Innovation

● CFB技术采用生石灰（CaO）的消化及灰循环增湿的一体化设计，保证高品质消石灰（$Ca(OH)_2$）立刻投入循环脱硫反应；

● 利用循环灰携带水分，在粉尘颗粒的表面形成水膜。粉尘颗粒表面的薄层水膜在一瞬间蒸发在烟气流中，在极短的时间内形成温度和湿度适合的理想反应环境，同时也克服了传统半干法脱硫反应器中可能出现的粘壁问题；

● 由于建立理想反应环境的时间减少，使得总反应时间大大降低成为可能，可有效地降低脱硫反应器高度；

● 烟气在反应器中高速流动，整个装置结构紧凑、体积小、运行可靠。装置的负荷适应性好；

● 脱硫副产物为干态，系统无水产生。终产物流动性好，适宜用气力输送。脱硫后烟气不必再加热可直接排放，根除白色烟雨；

● 对吸收剂要求不高，可广泛取得；

● 通过减小吸收塔的尺寸和降低占地面积以及避免采用复杂昂贵的消化制备系统，大大降低了初投资和运行费用；

● 脱硫效率高，脱硫效率可达90%以上。

● The CFB technology adopts the integrated design of quick lime (CaO) digestion and ash circulation humidification to ensure that high-quality slaked lime ($Ca(OH)_2$) is immediately put into the circulation desulfurization reaction;

●Circulating ash is used to carry water to form a water film on the surface of the dust particles. The thin water film on the surface of the dust particles evaporates in the flue gas flow in an instant, forming an ideal reaction environment with suitable temperature and humidity in a very short time, and this also overcomes the stickiness problem that may occur in the traditional semi-dry desulfurization reactor;

●Due to the reduced time to establish an ideal reaction environment, it is possible to greatly reduce the total reaction time, which can effectively reduce the height of the desulfurization reactor;

●The flue gas flows at high speed in the reactor. The whole device has compact structure, small cubage and reliable operation. The load adaptability of the device is good;

●The by-products of desulfurization are in dry state, and no water is produced in the system. The final product has good fluidity and is suitable for pneumatic conveying. After desulfurization, the flue gas can be directly discharged without being heated, and the white smoke and rain can be eradicated;

● The requirements for absorbent are not high which can be widely obtained;

● By reducing the size of the absorption tower and reducing the land space and avoiding the use of complicated and expensive digestion preparation systems, the initial investment and operating costs are greatly reduced;

●It has high desulfurization efficiency, and desulfurization efficiency can reach more than 90%.

■石灰石（石灰）—石膏法脱硫技术
Limestone (lime) - gypsum desulfurization technology

一、化学原理Chemical principle

烟气中SO_2、SO_3遇到液滴中的水后会发生如下反应：

$SO_2+H_2O \rightarrow HSO_3^-+H^+$

$SO_3+H_2O \rightarrow H_2SO_4$

生成的H_2SO_4将被石灰石迅速中和，以维持SO_2和SO_3的有效而持久的吸收。

与石灰石反应

SO_2、SO_3与下降浆液液滴中的细小石灰石颗粒反应：

$CaCO_3 + H_2SO_3 \rightarrow CaSO_3+CO_2\uparrow+H_2O$

$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + CO_2\uparrow+H_2O$

上述为离子反应，因此反应在溶液中发生。

氧化反应

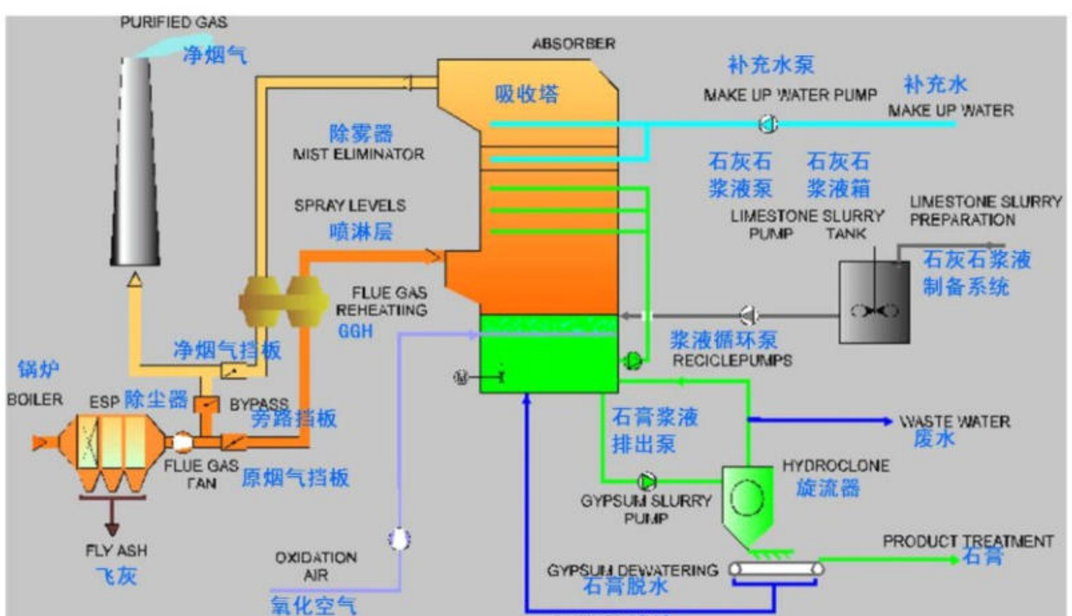
送入吸收塔浆池的空气将亚硫酸盐氧化成硫酸盐：

氧化：$CaSO_3 + 1/2O_2 \rightarrow CaSO_4$

氧化反应后接着就是石膏结晶：

结晶：$CaSO_4 + 2H_2O \rightarrow CaSO_4 \cdot 2H_2O$

二、工艺流程图Process flow diagram



三、工艺原理介绍Process principle Introduction

该工艺采用石灰石作为脱硫吸收剂，石灰石经破碎磨细成粉状与水混合搅拌制成吸收浆液。在吸收塔内，吸收浆液与烟气混合，烟气中的二氧化硫与浆液中的碳酸钙以及鼓入的氧化空气进行化学反应，吸收脱除二氧化硫，最终产物为石膏，经石膏脱水系统处理后，滤饼产物入库可以综合利用，清液返回脱硫循环系统。脱硫后洁净烟气通过除雾器除去雾滴经烟囱排放。

The process uses limestone as the desulfurization absorbent. The limestone is crushed and pulverized into powder and mixed with water to make absorption slurry. In the absorption tower, the absorption slurry is mixed with the flue gas. The sulfur dioxide in the flue gas reacts with the calcium carbonate in the slurry and the oxidized air blown in to absorb and the sulfur dioxide will be removed. The final product is gypsum, which is processed by the gypsum dehydration system. The filter cake product can be used comprehensively in the storage, and the clear liquid is returned to the desulfurization circulation system. After desulfurization, the clean flue gas is removed through the mist eliminator and finally discharged to the standard through the chimney.

四、主要工艺系统设备及功能The main function of equipment and process systems

- 烟气系统：烟道、烟气挡板、密封风机和气-气换热器（GGH）等关键设备。
- 吸收系统：逆流空塔喷淋吸收塔，系统在塔中完成SO_2、SO_3等有害气体的吸收。
- 浆液制备系统：磨机（湿磨时用）、粉仓（干粉制浆时用）、浆液箱、搅拌器、石灰浆液输送泵。
- 石膏脱水系统：主要包括水力旋流器和真空皮带脱水机等关键设备。
- 事故浆液系统：主要由事故浆池、区域浆池及排放管路组成。
- 热控系统：包括完整的热工测量、自动调节、控制、保护及热工信号报警装置。

- Flue gas system: key equipment such as gas duct, flue gas baffle, sealed fan and gas-gas heater (GGH).
- Absorption system: it is counter-fluid empty spray and absorption tower. The system completes the absorption of SO_2, SO_3 and other harmful gases in the tower.
- Slurry preparation system: mill (used for wet grinding), powder silo (used for dry powder pulping), slurry tank, agitator, lime slurry conveying pump.
- Gypsum dehydration system: it mainly includes key equipment such as hydrocyclone and vacuum belt dehydrator.
- Emergency slurry system: It is mainly composed of slurry tank, regional slurry tank and discharge pipeline.
- Thermal control system: Include complete thermal measurement, automatic adjustment, control, protection and thermal signal alarm device.

五、技术创新Technological Innovation

- 脱硫效率高达98%以上，对煤种适应性强，可用于高中低含硫煤种；
- 脱硫剂来源广泛，价格低廉；
- 脱硫剂利用效率高，钙硫比一般为1.03左右；
- 脱硫产物为石膏（二水硫酸钙），可作为建材使用，也易于处理；
- 机组适用性强，系统利用率大于95%。

- The removal efficiency is as high as 98% or more, and the technology has strong adaptability to different coal types, and can be used for high, medium and low sulfur coal types;
- The sources of desulfurization agent are wide and the price is low;
- The utilization efficiency of desulfurization agent is high, and the calcium-sulfur ratio is generally about 1.03;
- The desulfurization product is gypsum (calcium sulfate dihydrate), which can be used as a building material and is easy for treatment;
- The unit has strong applicability and the system utilization rate is greater than 95%.

森源蓝天
SENYUAN LANTIAN

■ 氧化镁脱硫Magnesium desulfurization

一、化学原理Chemical principle

（1）氧化镁浆液的制备

MgO（固）$+H_2O \rightarrow Mg(OH)_2$（浆液）

$Mg(OH)_2$（浆液）$\rightarrow Mg^{2+}+2OH^-$

（2）SO_2的吸收

SO_2（气）$+H_2O \rightarrow H_2SO_3$

$H_2SO_3 \rightarrow H^++HSO_3^-$

$HSO_3^- \rightarrow H^++SO_3^{2-}$

$Mg^{2+}+SO_3^{2-}+9H_2O \rightarrow MgSO_3 \cdot 3H_2O+MgSO_3 \cdot 6H_2O$

$SO_2+MgSO_3 \cdot 6H_2O \rightarrow Mg(HSO_3)_2+5H_2O$

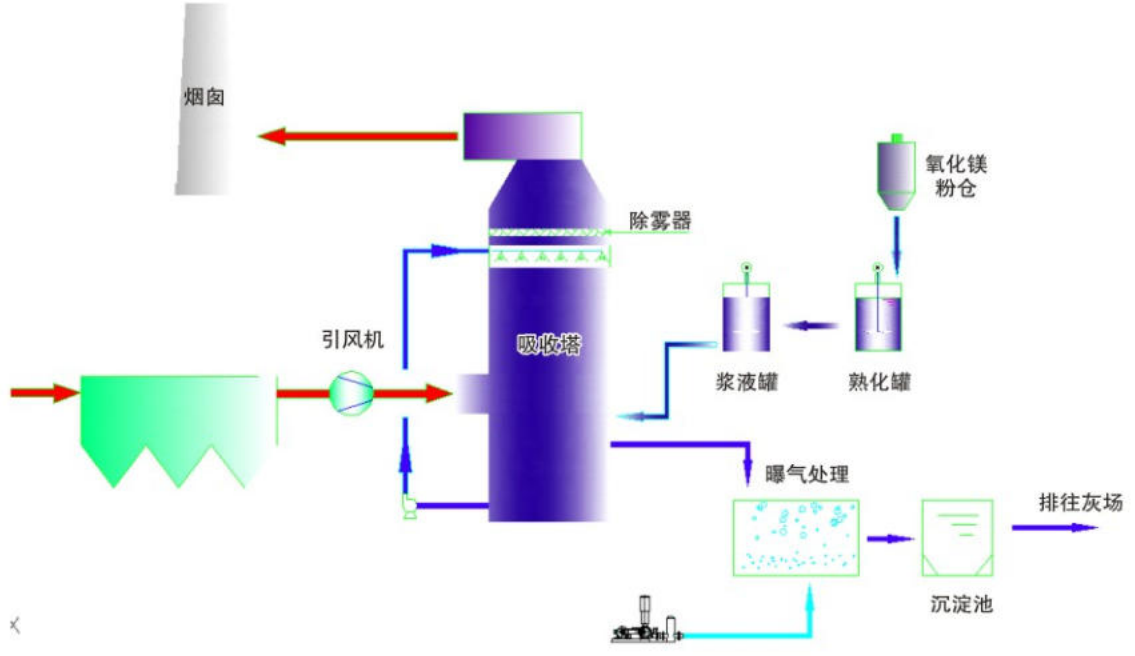
$Mg(OH)_2+SO_2 \rightarrow MgSO_3+H_2O$

$MgSO_3+H_2O+SO_2 \rightarrow Mg(HSO_3)_2$

（3）脱硫产物氧化

$MgSO_3+1/2O_2+7H_2O \rightarrow MgSO_4 \cdot 7H_2O$

二、工艺流程图Process flow diagram



三、工艺原理介绍Process principle introduction

氧化镁脱硫技术是一种成熟度仅次于钙法的脱硫工艺，它是镁的碱性氧化物与水反应生成氢氧化物，再与二氧化硫溶于水生成的亚硫酸溶液进行酸碱中和反应，氧化镁反应生成的亚硫酸镁，亚硫酸镁氧化后生成硫酸镁。

The magnesium FGD technology is a desulfurization process that is second only to the calcium method in maturity. It is the reaction of alkaline oxides of magnesium with water to form hydroxides, which reacts with the sulfuric acid solution generated by dissolving sulfur dioxide in water for neutralization reaction. Magnesium sulfite and magnesium sulfate are generated by the reaction of magnesium oxide, and magnesium sulfite is oxidized to produce magnesium sulfate.

四、主要工艺系统设备及功能The main function of equipment and process systems

- 烟气系统：烟道、烟气挡板门及密封装置等设备
- 吸收系统：逆流喷淋吸收塔，完成SO_2和SO_3的吸收
- 浆液制备系统：氧化镁粉仓、气化装置、除尘装置、计量输送装置、氧化镁浆液储槽、加药泵等
- 循环系统：再生池、沉淀浓缩池、循环池、氧化系统、各部分循环管道及泵等
- 控制系统：电气控制及热工仪表等

- Flue gas systems: gas duct, flue damper and sealing devices and other equipment
- Absorption system: it is counter-fluid empty spray and absorption tower. The system completes the absorption of SO_2 and SO_3 in the tower
- Slurry preparation system: magnesium oxide powder silo, gasification device, dust removal device, metering conveyor, magnesium oxide slurry storage tank, dosing pump, etc
- Circulation system: regeneration tank, sedimentation and concentration tank, circulation tank, oxidation system, various circulation pipes and pumps, etc
- Control system: electrical control and thermal instruments

五、技术特点Technical characteristics

- 氧化镁原料取得容易——我国拥有丰富的氧化镁资源，储量约为160亿吨，占全世界的80%左右；
- 循环浆液含固量低，不易结垢，不会堵塞；
- 脱硫效率高；
- 投资省，运行成本低；
- 运行可靠性高，烟气波动适应性强；
- 脱硫产物易处置，同条件下污泥量仅为石灰石－石膏法的1/20。

- Magnesium oxide raw materials are easy to obtain as China has abundant magnesium oxide resources with reserves of about 16 billion tons, accounting for about 80% of the world;
- The circulating liquid is in the form of solution, which is not easy to scale and will not block;
- High desulfurization efficiency;
- Save investment, low operating cost;
- High operation reliability and strong adaptability of flue gas fluctuation;
- The desulfurization products are easy to dispose, and the amount of sludge under the same conditions is only 1/20 of the limestone-gypsum method.

■ 双碱法（钠-钙）脱硫Dual-alkali desulfuration technique

一、化学原理Chemical principle

（1）吸收Absorb

$NaOH+SO_2 \rightarrow NaHSO_3$

$Na_2SO_3+SO_2+H_2O \rightarrow 2NaHSO_3$

含亚硫酸氢钠的吸收液采用液碱中和，得到亚硫酸钠：

$NaOH+NaHSO_3 \rightarrow Na_2SO_3+H_2O$

（2）置换再生 Replacement of regeneration

当含亚硫酸钠的吸收液与石灰水相遇混合时，发生如下反应：

$Ca(OH)_2+Na_2SO_3 \rightarrow CaSO_3\downarrow+2NaOH$

即亚硫酸钙沉淀，而氢氧化钠重新被置换出来，进入吸收塔吸收二氧化硫。

（3）氧化Oxidation

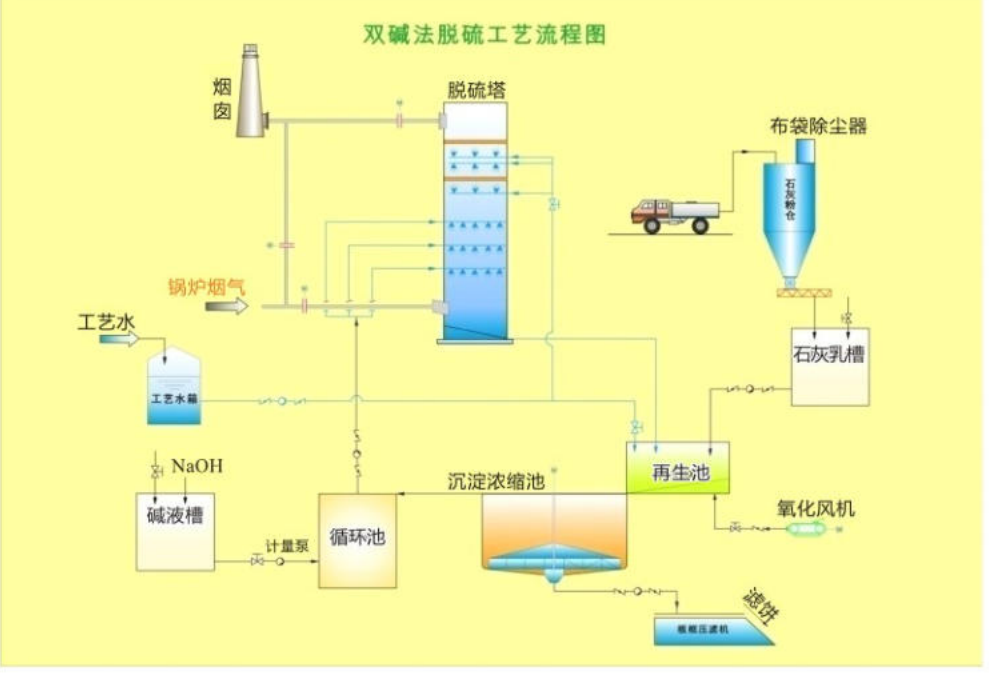
当浆液与烟气中氧气和鼓入的空气接触时，会发生如下反应：

$NaHSO_3+O_2 \rightarrow Na_2SO_4+H_2O$　　$Na_2SO_3+O_2 \rightarrow Na_2SO_4$

$NaOH+SO_3 \rightarrow NaHSO_4$　　$Na_2SO_4+SO_3+H_2O \rightarrow 2NaHSO_4$

$NaOH+NaHSO_4 \rightarrow Na_2SO_4+H_2O$　　$Ca(OH)_2+Na_2SO_3 \rightarrow CaSO_3\downarrow+2NaOH$

二、工艺流程图Process flow diagram



三、工艺原理介绍Process principle introduction

即采用Na_2CO_3或NaOH溶液为第一吸收液，再用石灰溶液为第二碱液使之再生，再生后溶液继续循环使用。此法得到的脱硫副产物仍以$CaSO_4$的形式沉淀出来。由于其产物的生产过程在吸收塔外，所以避免了结垢和堵塞。

That is, Na_2CO_3 or NaOH solution is used as the first absorption liquid, and then lime solution is used as the second alkaline solution to regenerate it, and the solution continues to be recycled after regeneration. The SO_2 obtained by this method is still precipitated in the form of $CaSO_3$ or $CaSO_4$. Since the production process of its products is outside the absorption tower, scaling and plugging are avoided.

四、主要工艺系统设备及功能The main function of equipment and process systems

- 烟气系统：烟道、烟气挡板门及密封装置等设备；
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- 浆液制备系统：石灰粉仓、气化装置、除尘装置、计量输送装置、石灰乳槽、加药泵等；
- 循环系统：再生池、沉淀浓缩池、循环池、氧化系统、各部分循环管道及泵等；
- 控制系统：电气控制及热工仪表等。

- Flue gas systems: gas duct, flue damper and sealing devices and other equipment;
- Absorption system: it is counter-fluid empty spray and absorption tower. The system completes the absorption of SO_2&SO_3 in the tower;
- Slurry preparation system: lime powder silo, gasification device, dust removal device, metering conveying device, lime trough, dosing pump, etc;
- Circulation system: regeneration tank, sedimentation and thickening tank, circulation tank, oxidation system, various parts of circulation pipes and pumps, etc;
- Control system: electrical control and thermal instruments etc.

五、技术特点Technical characteristics

- 双碱法脱硫系统可与除尘相结合，采用除尘脱硫一体化装置，同时进行脱硫和除尘；
- 钠碱吸收剂反应活性高、吸收速度快，可降低液气比，从而既可降低运行费用，又可减少水池、水泵和管道的投资；
- 塔外循环，不存在塔内结垢和浆料堵塞问题；
- 钠碱循环利用，损耗少；
- 石灰作为再生剂（实际消耗物），安全可靠，来源广泛，价格低；
- 操作简便，系统可长期运行稳定。

- The double-alkali desulfurization system can be combined with dust removal, using an integrated dusting and desulfurization device to simultaneously perform desulfurization and dust removal;
- Sodium-alkali absorbent has high reaction activity with fast absorption speed, which can reduce the liquid-gas ratio. This can not only reduce operating costs, but also reduce investment in pools, pumps and pipelines;
- with circulation outside the tower, there is no problem of scaling and slurry plugging inside the tower;
- Recycling of sodium and alkali lead to less loss;
- As a regenerant (actual consumable), lime is safe and reliable, with a wide range of sources and low prices;
- Easy to operate; the system can run stably for a long time.

烟气脱硝技术 FLUE GAS DENITRATION TECHNOLOGY

■ SNCR脱硝技术 Denitration

一、化学原理Chemical principles

锅炉燃烧的烟气中氮氧化物包含了 NO 和NO_2，而 NO占到烟气中 NO_x 的90%以上。所以脱硝过程以去除NO 为主。

化学反应方程式为：Its chemical equation as following:

$CO(NH_2)_2 \rightarrow 2NH_2 + CO$

$NH_2 + NO \rightarrow N_2 + H_2O$

$CO + NO \rightarrow N_2 + CO_2$

总的反应式为：The general equation as following:

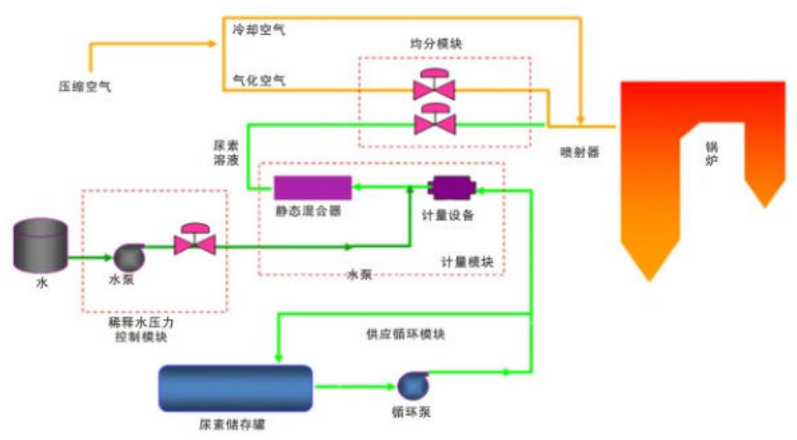
$NO + CO(NH_2)_2 + 1/2O_2 \rightarrow 2N_2 + CO_2 + 2H_2O$ …… (1.1)

$4NH_3 + 5O_2 — 4NO + 6H_2O$ …… (1.2)

在适当的炉膛温度下 NO_x 与还原剂（尿素）反应，生成无害的氮气、二氧化碳和水（见式1.1）。在温度过高的情况下尿素本身也会被氧化成 NO_x，反而会增加 NO_x 的排放（见式1.2）。

At an appropriate furnace temperature, NO_x reacts with the reducing agent (urea) to produce harmless nitrogen, carbon dioxide, and water (see Equation 1.1). When the temperature is too high, urea itself will also be oxidized to NO_x, which will increase NO_x emissions (see Equation 1.2).

二、工艺流程图Process flow diagram



三、工艺原理介绍Process principles Introduction

在无催化剂的作用下，利用还原剂将烟气中的氮氧化物还原为无害的氮气和水。“选择性非催化还原反应”(Selective Non-Catalytic Reduction,简称SNCR)是一种无需催化剂的脱硝方式，为得到较强的化学反应活性，SNCR技术需在较高的炉膛温度（900-1150℃）下，用氨或尿素等氨基还原剂来选择性地还原烟气中的NO_x。

一般来说，还原剂在炉膛或烟道内较难均匀混合，SNCR的脱硝效率将低于50%，而需要催化剂的SNCR的脱硝效率可达到90%以上。由于SNCR脱硝技术投资成本较低、改造方便，适宜协同应用其他脱硝技术，因而在燃煤锅炉，尤其是老厂脱硝改造上还是取得了广泛的应用。

In the absence of a catalyst, the reducing agent is used to reduce the nitrogen oxides in the flue gas to harmless nitrogen and water. "Selective Non-Catalytic Reduction" (SNCR) is a denitration method that does not require a catalyst. In order to obtain strong chemical reaction activity, SNCR technology needs to be at a higher furnace temperature (900-1150 ℃), an ammonia reducing agent such as ammonia or urea is used to selectively reduce NO_x in the flue gas.

Generally speaking, the reducing agent is difficult to mix evenly in the furnace or duct, and the denitration efficiency of SNCR will be less than 50%. However, the denitration efficiency of SNCR that needs a catalyst can reach more than 90%. Because SNCR denitration technology requires low investment cost and convenient modification, it is suitable for the coordinated application of other denitration technologies. Therefore, it has been widely used in coal-fired boilers, especially the denitrification retrofit project of old plants.

四、主要工艺系统设备及功能 The main function of equipment and process systems

- 还原剂存储与制备系统：储存系统的总储存容量按照锅炉SNCR装置BMCR工况下5天的总消耗量来设计；
- 计量分配、输送系统：计量分配系统设置过滤器，防止设备堵塞；
- 喷射系统：通过喷枪在合适的温度窗口将还原剂喷入炉内；
- 电气控制系统：配置完整、独立的仪表和控制系统。

- Reductant storage and preparation system: The total storage capacity of the storage system is designed according to the total consumption under the BMCR condition with boiler SNCR device for 5 days;
- Metering distribution and conveying system: The metering distribution system is equipped with a filter to prevent the equipment from being blocked;
- Spray and injection system: spray the reducing agent into the furnace through a spray gun at a suitable temperature;
- Electrical control system: complete and independent instrument and control system.

五、技术特点Technical characteristics

- 占地面积小，适合于老机组改造
- 不使用催化剂
- 投资省，运行费用较低
- 对煤种变化不敏感
- 建设周期短、施工简单
- 不需要更换引风机
- 使用安全的尿素还原剂
- 脱硝效率：40%~60%

- Less land occupation, suitable for the transformation of the old units
- No need to use catalyst
- Less Investment cost, lower operating costs
- Insensitive to changes in coal
- Short construction period, the construction is simple
- No need to replace the induced draft fan
- Use safe urea reductant
- Denitration efficiency: 40% to 60%

■ SCR脱硝技术 Denitration

一、化学原理Chemical principle

主要反应式

$4NO+4NH_3+O_2 \rightarrow 4N_2+6H_2O$

$2NO_2+4NH_3+O_2 \rightarrow 3N_2+6H_2O$（有利）

主要副反应

$4NH_3+3O_2 \rightarrow 2N_2+6H_2O$

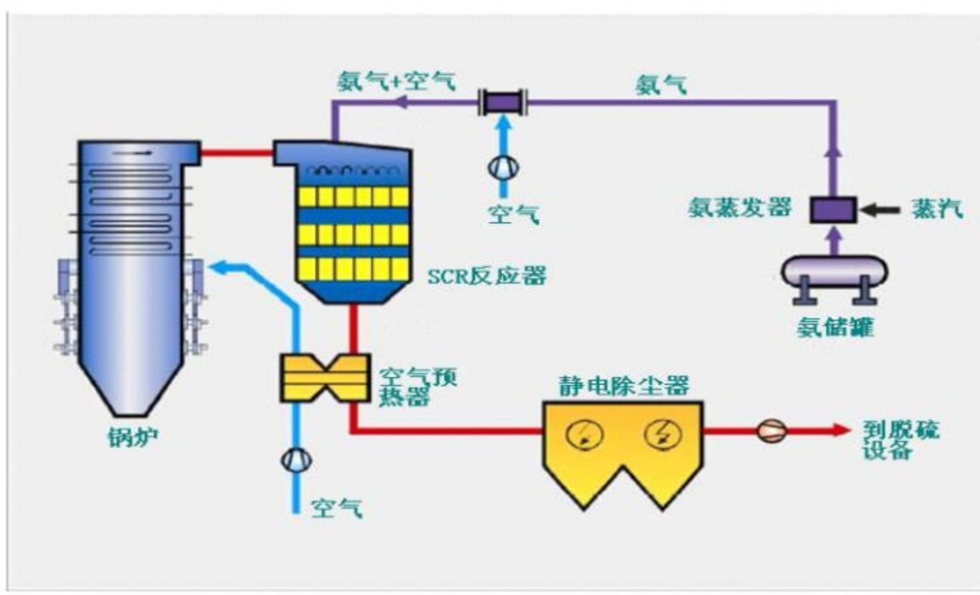
$NH_3+O_2+SO_3 \rightarrow NH_4HSO_4$（有害）

$NH_3+O_2 \rightarrow NO_X+H_2O$

300 ℃~420 ℃是SCR脱硝“效率、安全、经济”平衡的选择温度区间。

300℃ ~ 420℃ is the selected temperature range for SCR denitration which strike a balance for“efficiency, safety and economy”.

二、工艺流程图Process flow Diagram



三、工艺原理介绍Process principle Introduction

SCR脱硝技术已经成功应用于大量工业装置，原理是在催化剂的作用下，利用还原剂（液氨、氨水、尿素）在合适的温度区间内将烟气中的氮氧化物还原为无害的氮气和水。

反应原理：NO_X +还原剂 → 氮气 + 水

反应温度：300℃～420℃

还原剂：氨、尿素

催化剂：采用催化剂，需要催化反应器

反应器布置：在锅炉尾部烟道中

SCR denitration technology has been successfully applied to a large number of industrial installations. The principle is to use reducing agents (liquid ammonia, ammonia water and urea) to reduce the nitrogen oxides in the flue gas to harmless nitrogen and water in the appropriate temperature range under the action of the catalyst.

Reaction principle: NO_X + reducing agent → nitrogen + water

Reaction temperature: 300℃ ～420℃

Reducing agent: ammonia, urea

Catalyst: catalyst requires a catalytic reactor

Reactor arrangement: in the flue duct at the rear of the boiler

四、主要工艺系统设备及功能The main function of equipment and process systems

- SCR反应器/催化剂系统：反应器本体是脱硝装置最重要的部分，外型为矩形立方体，四壁为侧板，并形成壳体，催化剂布置在壳体内；
- 催化剂模块：催化剂是SCR工艺的核心部件，其性能的优劣将直接影响到脱硝效率和运行寿命；
- 烟气/氨的混合系统：在稀释风机的作用下，完成烟气/氨的混合，通过喷氨格栅喷入到反应器内；
- 氨的储备与供应系统：氨水溶液通过卸氨泵送至氨水溶液储存罐储存，而后通过循环泵输送至计量混合模块；
- 稀释水系统：稀释混合器宜采用静态混合器；
- 吹灰系统：采用声波吹灰器，防止灰尘在催化剂表面沉积，影响催化剂活性；
- 电控系统：电气控制及热工仪表等。

- SCR reactor/catalyst system: the reactor body is the most important part of the denitration device. The appearance is a rectangular cube. The four walls are side plates. These form a shell with the catalyst arranged in the shell;
- Catalyst module: The catalyst is the core component of the SCR process, and its performance will directly affect the denitration efficiency and operating life;
- The flue gas/ammonia mixing system: under the action of the dilution fan, the flue gas/ammonia mixing is completed and sprayed into the reactor through the ammonia spray grid;
- Storage and supply system for ammonia: the reducing agent is stored in the ammonia storage tank through the unloading device, and then sent to the metering and mixing module through the circulation pump;
- Dilution water system: Dilution mixer should adopt static mixer;
- Ash-blowing system: Adopt sonic or steam ash blower to prevent dust from depositing on the surface of the catalyst and affecting the activity of the catalyst;
- Electrical control system: electrical control and thermal instruments etc.

五、技术特点Technical characteristics

- 脱硝效率高，可达90%以上。
- 是国内外最成熟可靠的脱硝技术。
- 脱硝效率高，系统运行安全稳定。
- 工程投资较大。
- 燃用高灰分、高钙份煤种时容易发生积灰堵塞。

- It has high denitration efficiency, which can reach more than 90%.
- It is the most mature and reliable denitration technology at home and abroad.
- High denitration efficiency and safe and stable system operation.
- The project investment is relatively large.
- When burning coal with high ash content and high calcium content, ash accumulation is easy to occur.

■ SCR+SNCR联合脱硝技术SCR+SNCR combined denitration technology

一、化学原理Chemical principles

反应过程Chemical principle

$CO(NH_2)_2 + 2NO \rightarrow 2N_2 + CO_2 + 2H_2O$

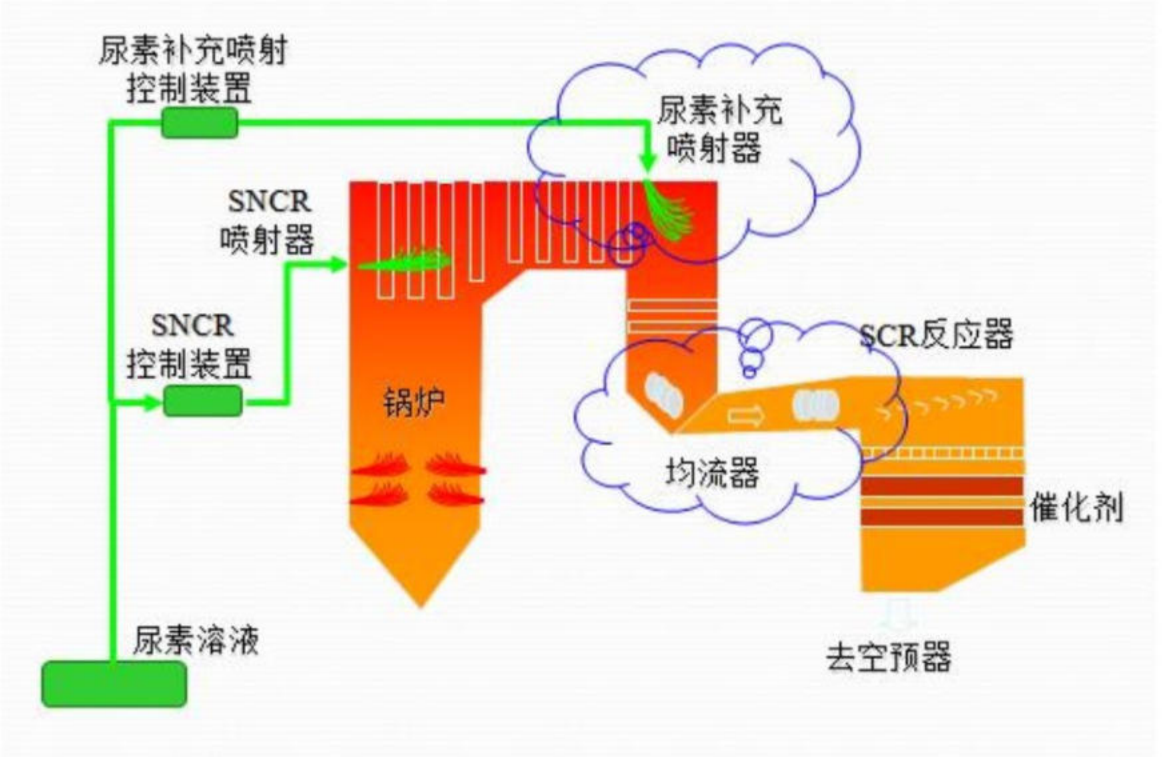
$CO(NH_2)_2 + H_2O \rightarrow 2NH_3 + CO_2$

$NO + NO_2 + 2NH_3 \rightarrow 2N_2 + 3H_2O$

$4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$

$2NO_2 + 4NH_3 + O_2 \rightarrow 3N_2 + 6H_2O$

二、工艺流程图Process flow diagram



三、工艺原理介绍Process principles Introduction

SCR/SNCR联合脱硝技术工艺发挥了工艺投资省、脱硝效率高的优势，将SNCR工艺的还原剂喷入炉膛技术与SCR工艺利用逃逸氨进行催化反应结合起来，进一步脱除 NO_x。混合脱硝工艺以尿素作为吸收剂，是炉内一种特殊的SNCR工艺与一种简洁的后端SCR脱硝反应器有效结合。

The SCR/SNCR combined denitration technology process takes advantage of the low cost of the process and high denitration efficiency. It combines the reducing agent of the SNCR process into the furnace and the SCR process which uses escaped ammonia to carry out the catalytic reaction to further remove NO_x. The mixed denitration process uses urea as an absorbent, which is an effective combination of a special SNCR process in the furnace and a simple end SCR denitration reactor.

四、主要工艺系统设备及功能The main function of equipment and process systems

- 还原剂存储与制备系统：储存系统的总储存容量按照锅炉脱硝装置BMCR工况下5天的总消耗量来设计；
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- 脱硝反应器：反应器本体是脱硝装置最重要的部分，外型为矩形立方体，四壁为侧板，并形成壳体，催化剂布置在壳体内；
- 电气控制系统：配置完整、独立的仪表和控制系统。

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- Denitration reactor: the reactor body is the most important part of the denitration device. The appearance is a rectangular cube. The four walls are side plates. These form a shell with the catalyst arranged in the shell;
- Electric control system: complete and independent instrument and control system.

五、技术特点Technical characteristics

- 远远小于传统SCR系统成本即可达到90%的脱硝效率；
- 减少SCR催化剂的使用量从而减少SO_2到SO_3的转换；
- SO_2/SO_3转化所引起的腐蚀和空预器阻塞问题小；
- 较SCR反应器小，具有更好的空间适用性；
- 脱硝系统阻力低，催化剂用量少，运行费用低；
- 可以安全地使用尿素作为还原剂，无需热解系统；
- 分步实施，分期到位。

- The denitration efficiency (90%) can be achieved with far less cost compared with the traditional SCR system;
- Reduce the consumption of SCR catalyst to reduce the conversion of SO_2 to So_3;
- The problem of corrosion and air preheater blockage caused by SO_2/SO_3 conversion is small;
- It is smaller than the SCR reactor and has better space applicability;
- The resistance of the denitration system is low. The consumption of catalyst is less, and the operating cost is low;
- It is safe to use urea as reducing agent without pyrolysis system;
- Step-by-step implementation; carried out by stages.

森源蓝天
SENYUAN LANTIAN

■ COA协同脱硝技术
Denitrification technology assisted with catalytic oxidation absorption

COA技术介绍 COA Technology Introduction

生物质直燃锅炉由于其燃料的特殊性，其脱硝系统应用SCR技术难度较高，存在运行风险，所以目前针对脱硝基本就只配置了SNCR装置，其单级脱硝效率存在工艺局限性，应对超净排放存在不小的难度，且在炉膛内喷射过量的氨水或尿素溶液对锅炉本体及后续的空预器省煤器均有一定的影响。COA脱硝利用系统的半干法脱硫塔，在其前段烟道和塔上布置双流体喷枪，喷射亚氯酸钠溶液，对温度不敏感，配合锅炉的SNCR系统，保证SNCR和COA综合脱硝效率，满足生物质燃料锅炉的脱硝超净排放的需要。

可大幅减少炉内SNCR还原剂的喷射量，降低锅炉过热系统的积灰及堵塞风险，减少水冷壁的腐蚀，对于锅炉长期稳定运行有积极意义。

Due to the particularity of the fuel, it is difficult to apply SCR Technology in the denitration system of biomass fired boiler power generation project, and there are operational risks. Therefore, at present, only SNCR device is configured for denitration. The single-stage denitration efficiency has process limitations, and it is difficult to reach goal of ultra low emissions. In addition, excessive ammonia or urea solution is injected into the furnace, which will have certain influence on both air preheater and subsequent economizer. The semi dry desulfurization tower of the system is used for COA denitrification. Double fluid spray guns are arranged on the front flue and tower to spray sodium chlorite solution, which is not sensitive to temperature. With the SNCR system of the boiler, the comprehensive denitration efficiency of SNCR and COA is ensured, and the ultra clean denitration requirements of biomass fuel boiler are met.

It can greatly reduce the injection amount of SNCR reducing agent in the furnace, and reduce the risk of ash accumulation and blockage in the boiler's overheating system, and reduce the corrosion of the water cooling wall, which has a positive significance for the long-term stable operation of the boiler.

工艺原理介绍 Introduction to process principle

中性碱性环境时，脱硝反应式如下：
In a neutral alkaline environment, the denitration reaction formula is as follows:

$NaClO_2 \longrightarrow Na^+ + ClO_2^-$

$2NO + ClO_2^- \longrightarrow 2NO_2 + Cl^-$

$NO + ClO_2^- \longrightarrow NO_2 + Cl^-$

$4NO_2 + ClO_2^- + 4OH^- \longrightarrow 4NO_3^- + Cl^- + 2H_2O$

$2NO_2 + ClO^{2}- + 2OH- \longrightarrow 2NO_3- + ClO^- + 2H_2O$

酸性环境时，NaC1O$_2$会分解成ClO$_2$，脱硝反应式如下：
In an acidic environment, NaC1O$_2$ will decompose into ClO$_2$, and the denitration reaction formula is as follows:

$5NO + 3ClO_2 + 4H_2O \longrightarrow 5HNO_3 + Cl$

氧化协同脱硝系统与半干法脱硫装置协同作用。
The oxidation assisted denitration system cooperates with the semi-dry desulfurization device.

■ 主要工艺系统设备及功能
Process principle introduction

- 亚氯酸钠存储系统：配置有一个液体储罐和卸载泵，需要新做罐体的土建基础、防护围堰和防晒棚，并配有测温、测压、液位等监测系统和运行安全配套设施。
- 溶液输送和计量系统：由输送泵、流量调节、计量和混合等设备构成，需要的土建基础工作量较少。
- 喷射系统：主要由喷枪、液相和气相压力测量和调节装置构成。
- 电控系统：主要是为各个泵和仪表、阀门等供电，以及进行自动控制。

- Sodium chlorite storage system: equipped with a liquid storage tank and unloading pump, it needs to build a new civil foundation, protective cofferdam and sunshade for the tank body, and is equipped with monitoring systems for temperature measurement, pressure measurement and liquid level, as well as operation safety supporting facilities.
- Solution delivery and metering system: it is composed of delivery pump, flow regulation, metering and mixing equipment, which requires less civil engineering foundation work.
- Spray system: mainly composed of spray gun, liquid and gas pressure measuring and regulating devices.
- Electric control system: mainly for each pump and instrument, valve power supply, as well as automatic control.

技术特点 Technical characteristics

- 系统相对独立，对现有的设备影响很小，改造比较简单；
- 操作运行灵活，根据需要随时可以启停；
- 喷入现有塔内水量相对原脱硫减温水很少，不影响脱硫设备的正常运行；
- 布置在炉后的辅机设备上，不会对前段的锅炉、空预器、省煤器等重要设备造成影响；
- 喷枪主要布置在现有的塔内，半干法塔运行时其内壁长期沾有一层脱硫灰，喷入的溶液不会对塔壁造成影响；
- 采用小流量的双流体喷枪喷枪，雾滴较小，在脱硫塔内即汽化掉，不影响下游设备；
- 炉膛运行温度低不利于SNCR工作时，这是一个很好的补充解决手段；
- 系统设备和投资少，运行维护简单；
- 降低系统SNCR还原剂用量，降低锅炉水冷壁腐蚀及过热器积灰。

- The system is relatively independent and has little influence on the existing equipment, and the transformation is relatively simple;
- The operation is flexible and can be started and stopped at any time as required;
- The amount of water injected into the existing tower is less than the original desuperheating water, which does not affect the normal operation of desulfurization equipment;
- The auxiliary equipment arranged behind the boiler will not affect the boiler, air preheater, economizer and other important equipment in the front section;
- The spray gun is mainly arranged in the existing tower. During the operation of semi dry process tower, there is a layer of desulfurization ash on its inner wall for a long time, and the injected solution will not affect the tower wall;
- Small flow dual fluid spray gun is adopted, which makes the droplets smaller and vaporizes in the desulfurization tower without affecting the downstream equipment;
- When the furnace temperature is low, it is a good supplementary solution;
- The system has less equipment and investment, and simple operation and maintenance;
- Reduce the amount of SNCR reducing agent in the system and corrosion on boiler water wall and dust accumulation on superheater.

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气力输送系统
PNEUMATIC CONVEYING SYSTEM

■ 高压（浓相）气力输灰
High Pressure (Concentrated Phase) Pneumatics Transmission

仓式泵气力输送系统是结合流态化和气固两相流技术研制的，是一种利用压缩空气的动压能与静压能联合输送的高浓度气力输送系统。采用间歇式输送方式，通过仓泵配置的料位计及压力表信号，对进料阀、进气阀、出料阀等进行循环切换；每输送一仓飞灰，即为一个工作循环，每个工作循环分为四个阶段：进料阶段、加压流化阶段、输送阶段、吹扫阶段。

仓式泵最关键的技术是必须将物料在仓泵内得到充分的流态化，而且边流化边输送，改悬浮式气力输送为流态化气力输送。

Silo pump pneumatic conveying system is developed by combining fluidization and gas-solid two-phase flow technology. It is a high-concentration pneumatic conveying system that utilizes the combined dynamic pressure energy and static pressure energy of compressed air. Using intermittent conveying mode, the feed valve, intake valve, and discharge valve are cyclically switched through the level gauge and pressure gauge signal configured by the bin pump; conveying a bin of fly ash every time is a working cycle, and each working cycle is divided into four stages: feeding stage, pressurized fluidization stage, conveying stage, and purge stage.

The most critical technology of the silo pump is that the materials must be fully fluidized in the silo pump, and material is transported while fluidizing while changing the suspension pneumatic conveying to the fluidized pneumatic conveying.

工作原理 Working principle

正压浓相仓泵工作过程分为四个阶段:

● 进料阶段

进料阀打开，物料自由落入泵体内，当泵体内上升物料触及料位计后，料位计发出料满信号，进料自动关闭，完成进料过程。

● 流化加压阶段

进气阀自动开启，压缩空气进入泵体底部，扩散后穿过流化床，在物料充分流化同时，泵内气体上升。

● 输送阶段

当泵内压力达到一定值时， 压力传感器发出信号，出料阀自动开启，流化床上的物料流化加强，输送开始，泵内物料逐渐减少，此过程中流化床上的物料，始终处于边流化边输送。

● 吹扫阶段

当泵内物料输送完毕，压力下降到管道阻力时，指示灯发出信号，通气延续一定时间，压缩空气清扫管路，然后进气阀关闭，间隔一定时间，关闭出料阀，打开进料阀，完成一次输送循环。

Working principle

The working process of positive pressure dense phase bin pump is divided into four stages:

● Feeding stage

The feed valve is opened, and the material falls freely into the pump body. When the rising material in the pump body touches the level gauge, the level gauge sends a full signal, and the feed is automatically closed to complete the feed process.

● Fluidized pressure stage

The intake valve opens automatically. Then compressed air enters the bottom of the pump body, and diffuses through the fluidized bed. While the material is fully fluidized, the gas in the pump rises.

● Conveying stage

When the pressure in the pump reaches a certain value, the pressure sensor sends a signal. Then the discharge valve opens automatically, and the fluidization of the material on the fluidized bed begins to be enhanced. And the material in the pump gradually decreases. During this process, the material on the fluidized bed is always in state of conveying while fluidizing.

● Purge stage

When the material in the pump is delivered and the pressure drops to the resistance of the pipeline, the indicator light sends signals. And the ventilation continues for a certain period of time, while the compressed air cleans the pipeline. Then the intake valve closes. At a certain time, the discharge valve is closed and the feed valve is opened. And a delivery cycle is completed.

系统由以下部分组成
System consists of the following components

主要由泵体及进料阀、进气阀、出料阀等组成，并配置料位计、压力表及电磁阀箱等。

The main components are the pump body, the feeding valve, the air inlet valve, discharge valve, etc., and the system is equipped with the silometer, pressure gauge, and electromagnetic valve box, etc.

适用范围：Applicable scope

输送距离≤1000m；输送量≤100t/h；适用于中长距离输送的电厂除灰系统、建材、冶金、化工等行业各种粉体物料输送。

Conveying distance is not more than 1000m; conveying capacity is not more than 100t/h; the system is suitable for conveying various powder materials in power plant ash removal systems, building industry, metallurgy, chemical industry and other industries with medium and long distances.

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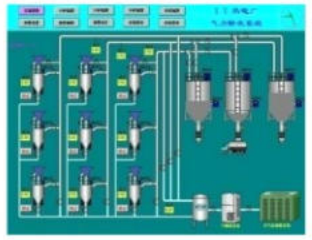
主要配件：Main Accessories

电控界面
Electric control interface



气力输送控制系统
Pneumatic conveying control system

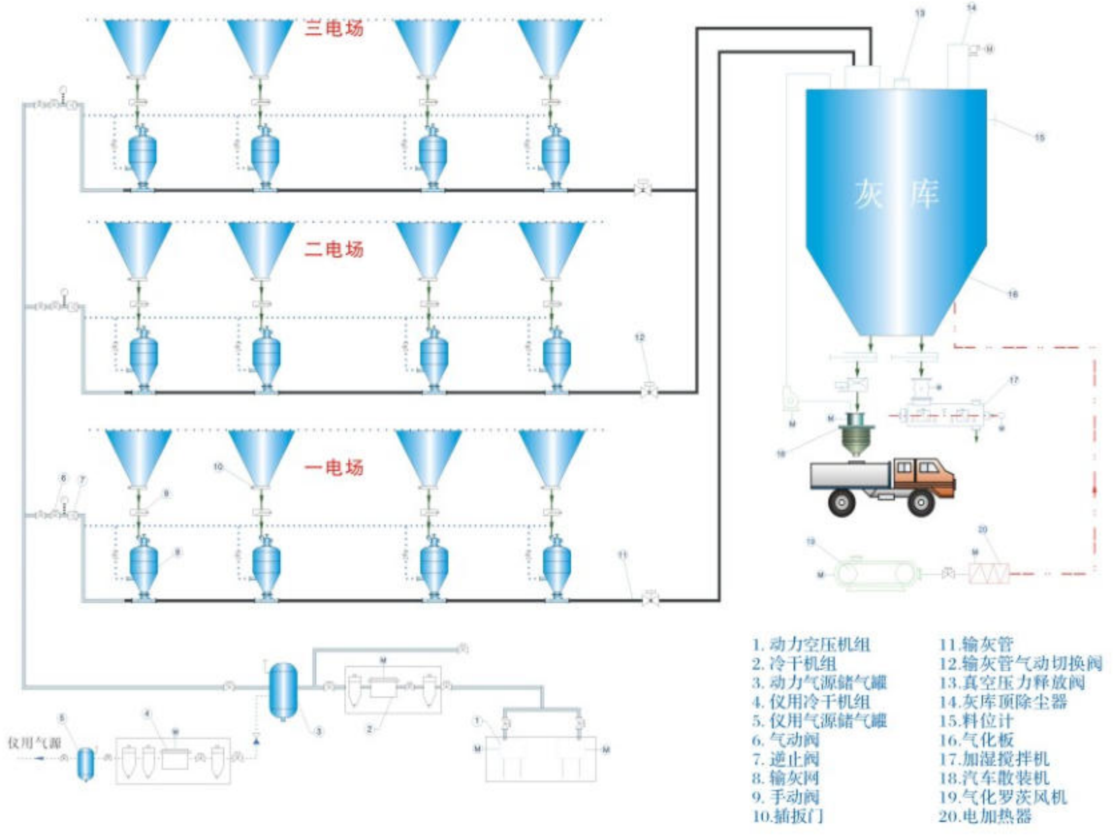
配图 Charts

仓泵
Sump pumps

进、出料阀
Inlet and discharge valve

流化板
Fluidization Plate

工艺流程图：Process flow diagram



■技术创新点 Technology innovation point

● 灰气比高，耗气量少，减少管道磨损力度。

● 输送距离远，满足各种复杂的场地布置需要。

● 多泵多级串联输送模式，能够减少频繁的输送次数，减少能耗，同时输送，始终保证灰斗下来的灰能同时并及时输空，不容易造成灰斗积灰。

● 多泵多级串联输送相对于数量多的灰斗单级输送泵模式，减少投资费用至少5%，运行简单，操作方便，减少故障点。

● 多泵多级串联输送系统，伴有助吹系统，使输送更加有推力，保证输灰系统的正常稳定运行，不易堵管。

● High ash-gas ratio, low gas consumption, reduce pipeline wear.

● The transportation distance is long, meet the needs of various complex site layouts.

● Multi-stage series conveying mode with multi-pump can reduce frequent conveying times, reducing energy consumption. Conveying at the same time ensure that the ash from the ash hopper can be emptied at the same time and timely. So it is not easy to cause ash accumulation.

● Multi-stage series conveying mode with multi-pump cost relatively less than the ash hopper single-stage conveying pump mode, which reduces the investment cost by at least 5%. It is simple to operate, easy to operate, and reduces failure points.

● Multi-stage series conveying mode with multi-pump, accompanied by a blowing system, provides the conveying more thrust. This guarantees the normal and stable operation of the ash conveying system, and blocking of the pipe is not easy to occur.

■ 微正压（稀相）气力输送
Micro positive pressure (dilute phase) pneumatic transmission

GSB型连续泵是利用气力压差原理与最先进的喷射流技术、流态化技术相结合，充分吸收现代气力输送两相流的理论。电动锁气器完成均衡给料作用后，粉状物料被卷吸进入气灰混合室，因送料器利用独特设计的喷嘴（产生高真空度即相对强负压）将物料及气体均匀混合，并将物料送入到输送管道，利用气力压差使物料沿管道送到目的地。

其核心技术是射流器喷嘴型式为环状, 使射流器既产生较高真空而又不产生紊流带来能耗损失，这是该设备有别于其它输送泵最关键的一点。

GSB型连续泵由电动锁气器和送料器（气灰混合室、喷嘴、文丘里管）两部分组成。

The GSB continuous pump is based on the combination of the principle of pneumatic pressure difference and the most advanced injection flow technology and fluidization technology. It fully uses the theory of modern pneumatic conveying two-phase flow. After the electric air lock completes the balanced feeding, the powdery material is sucked into the gas ash mixing chamber. The feeder uses a uniquely designed nozzle (generating a high vacuum, that is, a relatively strong negative pressure) to mix the material and gas uniformly, and the material is sent to the conveying pipeline, and the pneumatic pressure difference is used to send the material to the destination along the pipeline.

The core technology is that the nozzle of the jet aerator is ring-shaped, so that the jet aerator generates a higher vacuum without causing turbulent flow to cause energy loss, which is the most critical point of the equipment that is different from other delivery pumps.

GSB type continuous pump is composed of two parts: electric air locker and feeder (gas ash mixing chamber, nozzle, and venturi tube).

工作原理 Working principle

由气源来的低压空气，经调节阀（或减压阀）蝶式止回阀、活动风管、喷嘴进入泵体扩散室内，当粉状或颗粒状物料由落料斗落下进入喷嘴与扩压器之间的高速气流区时，即被吹散。加之底部气化装置的气化作用，使物料气化而成悬浮状态。此后即被高速气流送入扩压器的渐缩管内，流经喉部扩散管，进入输送管路，送至所要求的卸料点，即完成送料过程。

The low-pressure air from the air source enters the diffusion chamber of the pump body through the regulating valve (or pressure reducing valve), butterfly valve, movable air pipe, and nozzle. When the powdery or granular materials fall from the hopper, they enter the high-speed airflow area between the nozzle and diffuser and is blown away. Combined with the gasification effect of the bottom gasification device, the material is gasified into a suspended state. After that, material is sent into the reductive pipe of the diffuser by the high-speed airflow, and then material flows through the throat diffusion pipe, entering the conveying pipeline. And finally material is sent to the required discharge point, and the feeding process is completed.

适用范围：
Applicable scope

输送距离≤300m；输送量≤100t/h；适用于中短距离输送的电厂除灰系统、大型混凝土拌和站、建材、冶金、化工等行业各种粉体物料输送。

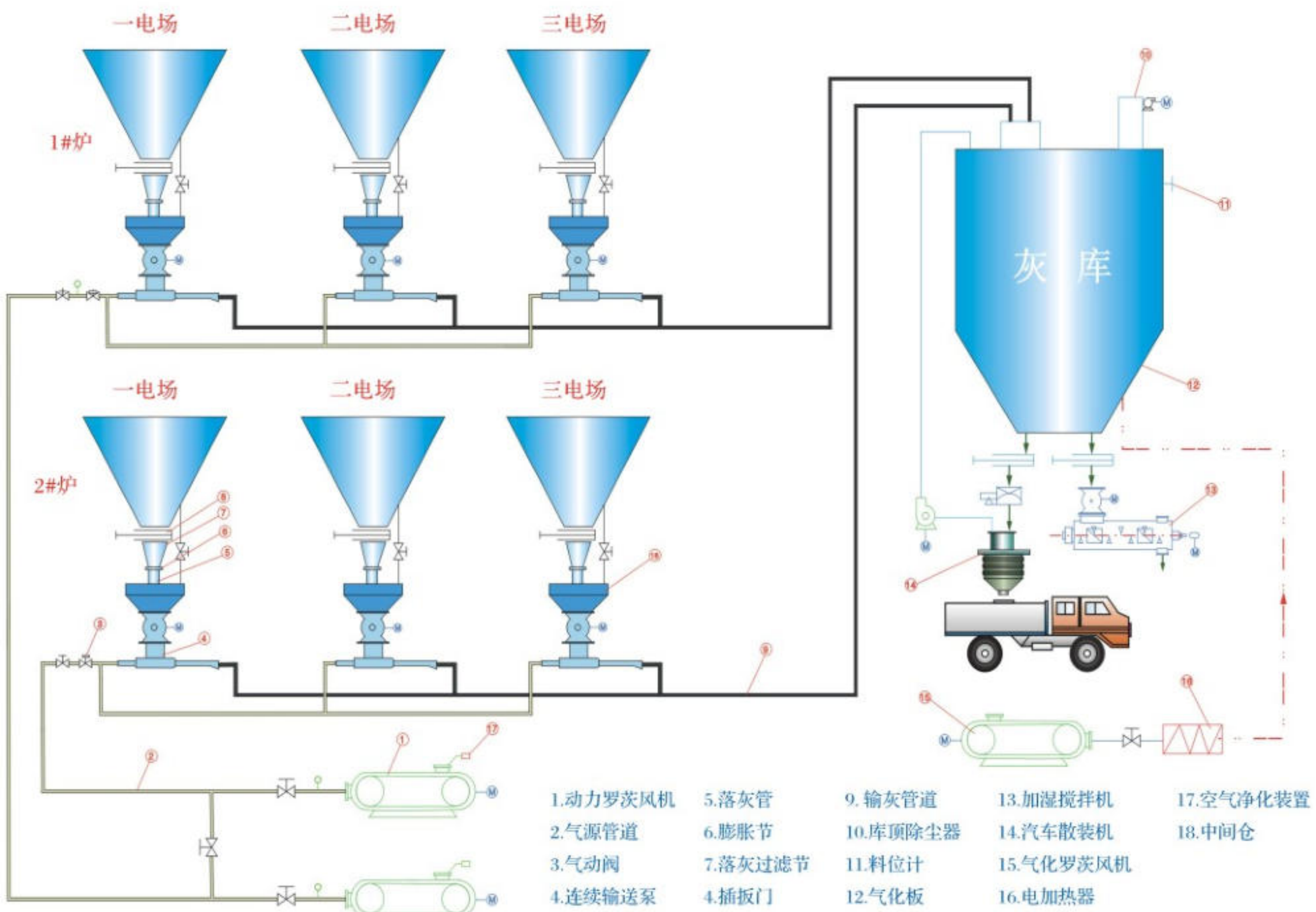
The conveying distance for the system is not more than 300m; and the throughput is not greater than 100t/h. The system is suitable for the dust removal system of power plant, and all kinds of powder materials conveying of large concrete mixing station, building industry, metallurgy, chemical industry, etc.

系统由以下部分组成：
System consists of the following components

动力（罗茨风机）、射流泵组、管道、阀门、库顶除尘器、灰库及灰库设备、仪表、控制系统

Power (Roots fan), jet pump unit, pipeline, valve, top dust collector, ash silo and equipment, instrument, control system

工艺流程图：
Process flow diagram



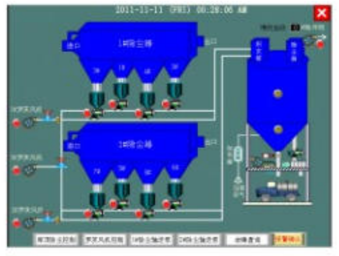
关键部件：
Critical component

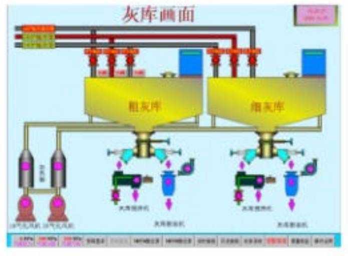

GSB泵
Pump


文丘里管
Venturi tube


喷嘴
Nozzle


中间仓
Intermediate bin


电控界面
Electric control interface


灰库界面
Library interface

■技术创新点 Technology innovation point

- 采用的是连续均匀给料输送的方式，输送浓度低，运行平稳，安全可靠，几乎不存在堵管的现象。
- 工艺简单，设备部件少，单台输送泵配置一台电动给料机，无气动元件，无频繁启动、关闭阀门和设备，故障率少，维护检修极其简单方便，几乎无易损件。
- 动力气源采用低压罗茨风机，能耗低，运行费用低，比浓相输灰系统节省20%。
- 采用低压动力源进行连续输送，管道内流速较低且恒定，管道磨损小，使用寿命长。
- 控制简单方便，自动程序如果出现问题，根据使用说明书手动一次性启动相应的设备，正常运行后，不需要进行频繁操作。
- 操作简便，对操作人员要求低，容易操作，不需要频繁操作。
- 由于输送泵的特殊性可以两个灰斗下使用一台输送设备，节省投资。

- The method of continuous and uniform feeding is adopted. The conveying concentration is low and the operation is stable. It is safe and reliable, and there is almost no pipe blocking.
- The process is simple, and the equipment parts are few. The single conveying pump is equipped with an electric feeder without pneumatic components or frequent starting & closing of valves and equipment. The failure rate is low, and maintenance and repair are extremely simple and convenient, and there are almost no wearing parts.
- The low-pressure roots blower is used as the power source, which has low energy consumption and low operating cost, and saves 20% cost compared to the dense phase ash delivery system.
- Adopt low-pressure power for continuous transportation. The flow velocity in the pipeline is low and stable. The pipeline wear is small, and the service life is long.
- The control is simple and convenient. If there is a problem with the automatic program, the corresponding equipment is manually started at once according to the instruction manual. After normal operation, no frequent operations are required.
- Convenient operation; low requirements for operators; easy to operate; no need for frequent operation.
- Due to the special nature of the delivery pump, one delivery device can be used under two ash hoppers, which reduces investment.

机械输送与计量系统
MECHANICAL CONVEYING AND METERING SYSTEM

■ 皮带带式输送系统 Belt conveyor system

皮带输机的工作原理 Working principle of belt conveyor

皮带输送机主要由两个端点滚筒及紧套其上的闭合输送带组成。带动输送带转动的滚筒称为驱动滚筒(传动滚筒)；另一个仅在于改变输送带运动方向的滚筒称为改向滚筒。驱动滚筒由电动机通过减速器驱动，输送带依靠驱动滚筒与输送带之间的摩擦力拖动。驱动滚筒一般都装在卸料端，以增大牵引力，有利于拖动。物料由喂料端喂入，落在转动的输送带上，依靠输送带摩擦带动运送袋卸料端卸出。输送带根据摩擦传动原理而运动，具有输送量大、输送距离长、输送平稳，物料与输送带没有相对运动，噪音较小，结构简单、维修方便、能量消耗少、部件标准化等优点。结构形式多样，有槽型皮带机、平型皮带机、爬坡皮带机、侧倾皮带机、转弯皮带机等多种形式。

The belt conveyor is mainly composed of two end rollers and a closed conveyor belt tightly sleeved on it. The roller that drives the conveyor belt to rotate is called the driving roller (drive roller); and the other roller that only changes the direction of the conveyor belt is called the redirecting roller. The driving roller is driven by the motor through the reducer, and the conveyor belt is driven by the friction between the driving roller and the conveyor belt. The driving roller is generally installed at the discharge end to increase the traction and facilitate dragging. The material is fed from the feeding end and falls on the rotating conveyor belt. The friction of the conveyor belt drives the transport bag to be discharged at discharge end. The conveyor belt moves according to the principle of friction transmission. It has the advantages of large conveying capacity, long conveying distance, stable conveyance, no relative movement between materials and conveyor belt, low noise, simple structure, convenient maintenance, low energy consumption, standardized components, etc. The structure has various forms, such as groove belt conveyor, flat belt conveyor, climbing belt conveyor, roll belt conveyor, turning belt conveyor and other forms.

应用范围 Application scope

采矿、冶金、木材、铸造、建材、电力等行业的输送和生产流水线以及水电站建设工地和港口等生产部门，用来输送松散物料或成件物品。

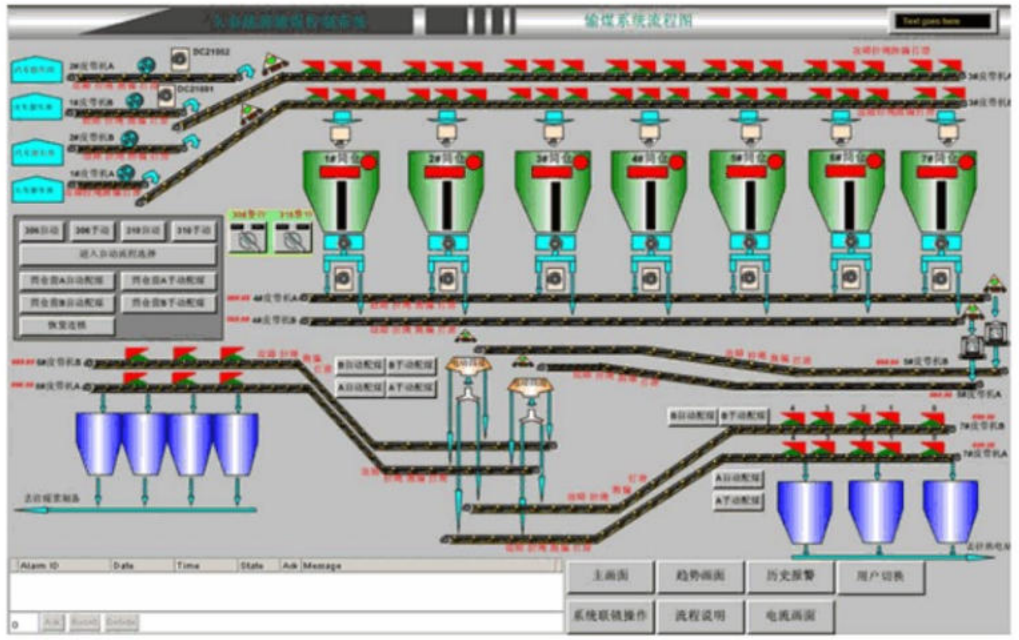
Belt conveyor system is able to be applied in transportation and production lines in mining, metallurgy, wood, casting, building materials, power, and other industries, as well as production departments such as hydropower station construction sites and ports. Belt conveyor systems are used to transport loose materials or finished goods.

系统由以下部分组成：
System consists of the following components

输送带、托辊、滚筒、滚柱逆止器、驱动装置、制动、张紧装置、改向、装载、卸载、清扫等装置、PLC控制系统等组成。

It consists of conveyor belt, idler, roller, roller backstop, drive device, braking, tensioning device, redirection, loading, unloading, cleaning and other devices, PLC control system, etc.

工艺流程图 Process flow diagram



■ 技术创新点 Technology innovation point

- 皮带输送机是物料最理想的高效连续运输设备
- 防皮带的跑偏装置
- 防皮带的纵撕装置
- 防电机异常转矩装置
- 配有公司自主研发的智能运输系统

- Belt conveyor is the most ideal and efficient continuous transportation equipment for materials
- Anti-belt deviation device
- Device for preventing longitudinal tearing of the belt
- Anti-motor abnormal torque device
- Equipped with an intelligent transportation system independently developed by SLETC

■ GX型螺旋计量系统 GX screw metering system

矢重秤是一款由森源蓝天自主研发推出的全新系列产品，运用了世界领先的动态控制技术，搭载了由森源蓝天研发团队专为矢重秤开发的动态称重控制器，通过实时调节螺杆、振动给料机、泵等各种执行机构的运行速度来控制给料流量，又称为稳流量给料器，广泛地运用于橡塑、环保、化工、食品、钢铁有色等行业的连续给料生产线上，矢重秤给料系统的应用，彻底颠覆了传统的手工配料模式，在配料发展史上具有深远的里程碑意义。

Loss in weight scale is a new series of product independently developed by SLETC. It uses the world's leading dynamic control technology. It is equipped with a dynamic weighing controller specifically developed by SLETC's R&D team for loss in weight scale. Loss in weight scale adjusts the running speed of various actuators such as screw, vibrating feeder, pump, etc. to control the feed flow, also known as steady flow feeder, widely used in continuous feed production line of different industries like rubber, plastic, environmental protection, chemical, food, nonferrous metals and other industries. The application of the feed system with loss in weight scale completely not only overturns the traditional manual batching mode, but also means an important milestone in the history of batching development.

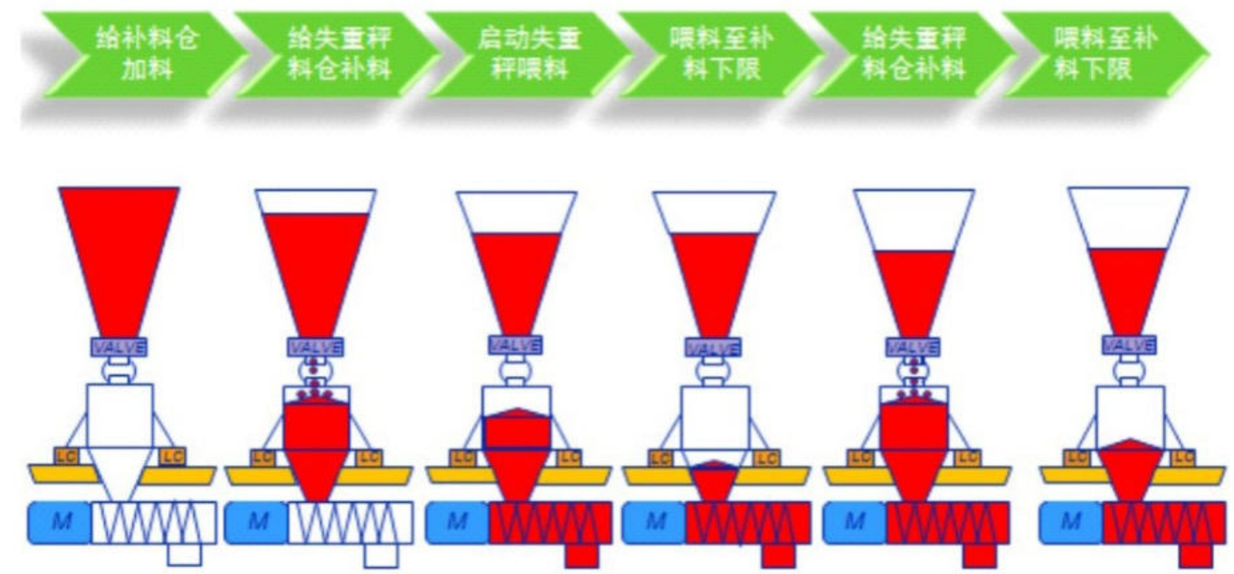
工作原理 Operating principle

高精度称重传感器用于实时测量料仓中物料的重量，当物料通过驱动及出料装置从物料出口排出时其重量将会减少，控制模块会将单位时间里重量减少的量跟所设定的单位时间里需要下料的量进行比较并调节驱动控制器使其保持一致，以达到精确喂料的目的。

Working principle: The high-precision weighing sensor is used to measure the weight of the material in the silo in real time. When the material is discharged from the material outlet through the drive and the discharge device, its weight will be reduced. And the control module will compare the reduced amount of material to targeted amount per unit time and then adjust the amount the drive controller to keep the amount consistent to achieve the purpose of accurate feeding.

典型失重秤工作流程示意图(仅供参考)

Work flow diagram of typical loss in weight scale



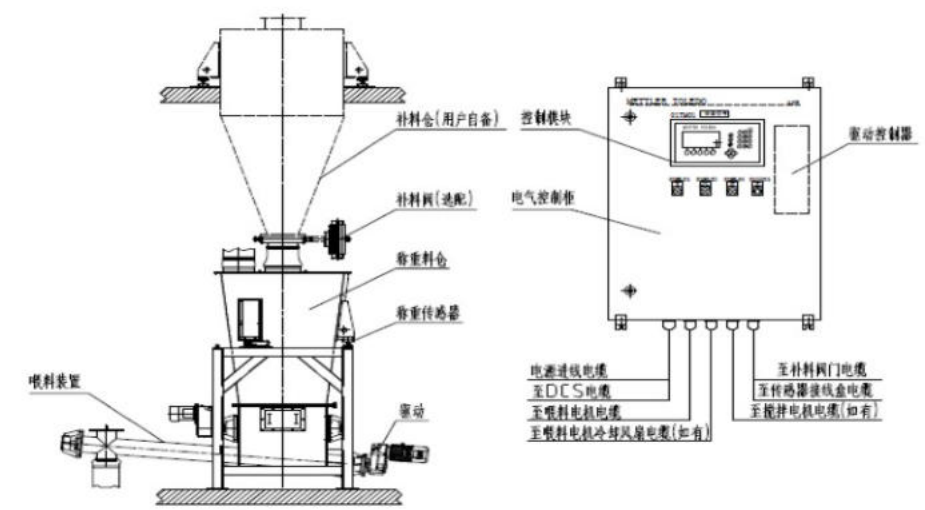
失重秤组件

失重秤主要由称重料仓、驱动及喂料装置、称重传感器、补料阀(选配)、驱动控制器、控制模块等组成。

Components: Loss in weight scale is mainly composed of weighing silo, driving & feeding device, weighing sensor, feeding valve (optional), driving controller, control module, etc.

失重秤组成及工作原理示意图

Composition and working principle diagram of loss in weight scale



细分行业工艺路线
Emission process in different industries

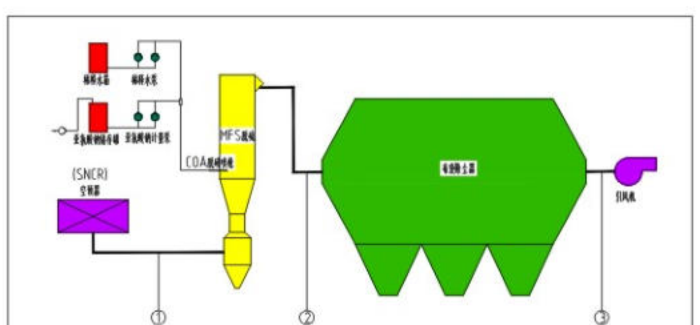
■ 生物质发电行业 Biomass industry

超低排放工艺
Ultra-low Emission Process

路线一：SNCR+MFS半干法+COA协同脱硝+布袋除尘器
Route 1:SNCR+MFS semi-dry method + COA synergistic denitration + bag-type dust remover

脱硫采用除尘器前的MFS半干法脱硫技术，脱硝采用SNCR+COA协同脱硝技术。MFS脱硫技术为森源蓝天针对生物质燃料锅炉特点开发的新一代脱硫技术，不采用传统的干法物料循环技术，简化了系统配置，避免了干法的塌床弊病，显著降低了脱硫系统和配套脱硫专用除尘器的投资，综合投资和运行成本降低2/5，系统简单实用，维护工作量大大减少。COA为森源蓝天针对生物质燃料锅炉脱硝的行业难题而开发的解决方案。在锅炉端利用SNCR进行一级脱硝，然后在MFS塔上和其前段烟道布置专用喷枪，喷射氧化剂，配合锅炉的SNCR系统，综合脱硝效率≥80%，保证烟囱出口NO_x排放浓度＜50mg/Nm^3，同时有效控制氨逃逸。

MFS semi-dry desulphurization technology before dust removers was used for desulphurization, and SNCR+COA coordinated denitration technology was used for denitration where MFS desulfurization technology refers to a new generation of desulfurization technology developed by Senyuan Blue Sky according to the characteristics of the biomass fuel boiler. It does not adopt the traditional dry material circulation technology, simplifies the system configuration, and avoids the bed collapse ills of dry method, significantly reducing the investment of desulfurization system and supporting special dust remover for desulphurization. Besides, its comprehensive investment and operating costs are reduced by 2/5, and with simple and practical system, its maintenance workload is also greatly reduced. Whereas COA is a solution developed by Senyuan Blue Sky for the industry problems of biomass fuel boiler denitration, where at the boiler end, SNCR is used for first-stage denitration, and then special spray gun is arranged on the MFS tower and its front flue to spray oxidant. In addition, combined with the SNCR system of boilers, the comprehensive denitration efficiency is more than 80%, the concentration of NO_x emission at the outlet of the chimney is ensured to be less than 50mg/Nm^3, and the ammonia escape is effectively controlled.



稀释水箱dilution water tank 稀释水泵 dilution water pump 亚硝酸钠储存罐sodium nitrite storage tank

亚硝酸钠计量泵 sodium nitrite metering pump 空预器air pre-heater 脱硝喷枪 denitration spray gun脱硫 desulfurization

优点：采用脱硫脱硝一体化技术，系统简单，布置紧凑，运行灵活，COA一次性投资低，适用于低硫、低氮的循环流化床生物质锅炉。

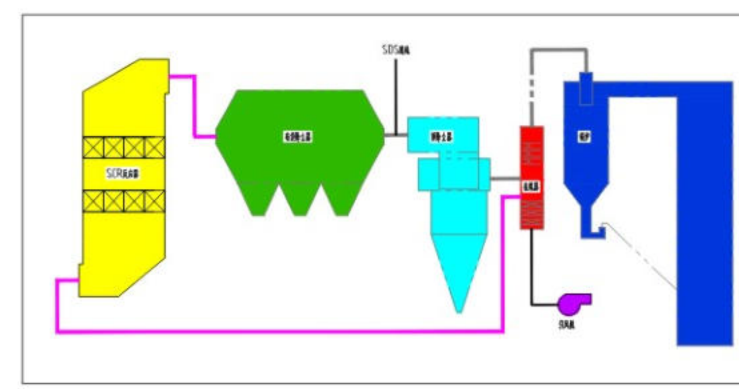
缺点：COA不适于高NO_x值的脱硝，否则运行成本较高。

Advantages: The use of desulfurization and denitration integration technology results in the system is simple, arrangement is compact, operation is flexible, and COA one-time investment is low, where it is suitable for circulating fluidized bed biomass boilers with low sulfur, and low nitrogen.
Disadvantages: COA is not suitable for the denitration with high NO_x value, otherwise the operation costs will be relatively high.

路线二：SDS干法+高温布袋除尘器+中温SCR脱硝
Route 2:SDS dry method + high temperature bag-type dust remover + medium temperature SCR denitration

烟气净化系统采用技术路线为"省煤器+高温旋风除尘+SDS干法脱硫+高温布袋除尘器+中温SCR"，然后烟气返回省煤器、空预器至引风机，满足目前国家最严格的"50355"排放标准，系统按脱硫进口SO_2浓度≤400mg/Nm^3、NO_x进口浓度≤400mg/Nm^3设计。脱硫剂采用小苏打，脱硝采用低尘、中温的SCR脱硝联合技术。

The flue gas purification system adopts the technical route of "economizer + high temperature cyclone dust removal +SDS dry-method desulfurization + high temperature bag-type dust remover + medium temperature SCR", in which the flue gas returns to the economizer, air pre-heater, and then enters the induced draft fan, meeting the current national most strict "50355" emission standard. In addition, the system is designed according to the standard that the SO_2 concentration for desulfurization in inlet end is less than or equivalent to 400mg/Nm^3 and the NO_x concentration for desulfurization in inlet end is also less than or equivalent to 400mg/Nm^3, where the desulfurizer adopts baking soda, and the denitration adopts SCR united denitration technology of low dust and medium temperature.



反应器 reactor 布袋除尘器 bag-type dust remover 预除尘器 pre-dust remover省煤器economizer 锅炉 boiler

优点：催化剂布置在除尘之后，消除了催化剂堵塞和碱金属中毒风险，SCR运行效率高，解决了传统生物质锅炉的SNCR带来的下级省煤器和空预器堵塞问题。

缺点：项目占地大，整体造价稍高，不适于改造项目。

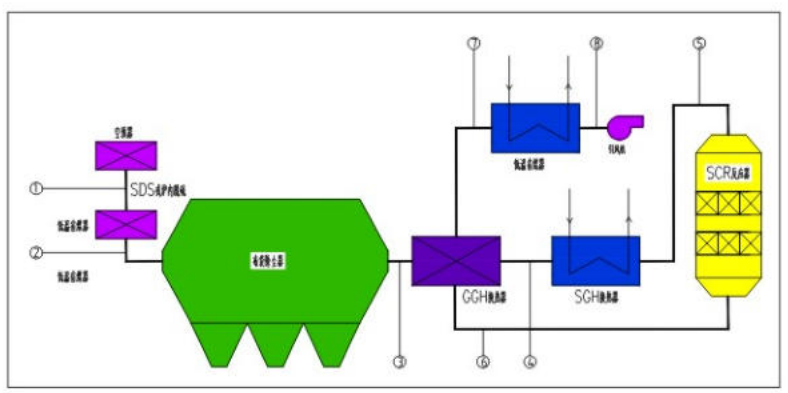
Advantages: The catalyst is arranged after the dust removal, which eliminates the risk of catalyst blockage and alkali metal poisoning and with high SCR operation efficiency, the problem of lower economizer and air pre-heater blockage caused by SNCR of traditional biomass boiler is solved.
Disadvantages: the project covers a large area, the overall cost is slightly higher, and it is not suitable for renovation projects.

路线三：SDS干法+布袋除尘器+低温SCR脱硝

Route 3:SDS dry method+ bag-type dust remover + low temperature SCR denitration

烟气流程：从锅炉尾部排放的低温含尘烟气首先进入除尘系统，净化后的烟气由于温度较低需要首先进入GGH换热器和SGH进行加热，烟气温度保持在160℃以上，加热后的烟气进入SCR反应器，在低温催化剂的作用下进行NO_x脱除后引入GGH换热器与原烟气进行换热，然后将烟气进入低温省煤器进一步降温到110度左右，再将烟气排至引风机，最后一级降温热源可用于加热除氧器或热网回水。此工艺路线的脱硫一般采用炉内干法或SDS干法脱硫工艺，半干法脱硫降温较多，不适于此工艺。

Flue gas flow: First of all, the dusty low temperature flue gas emitted from the boiler tail accesses to the dust removal system, then due to the low temperature, the purified flue gas enters the GGH heat exchanger and SGH to be heated, resulting in the temperature of flue gas keeps above 160 ℃, and later under the action of low temperature catalyst, the heated flue gas enters the SCR reactor to conduct NO_x removal and accesses to the GGH heat exchanger to transfer heat with raw flue gas. Next until the flue gas into the low temperature economizer is further cooled to about 110 ℃, it is emitted to the induced draft fan where the last level of cooling heat source can be used to the heated deaerator and the heated deaerator or the heated net backwater.For such an desulphurization technology, the dry method within the furnace or SDS dry-method desulphurization process are generally adopted, while the semi-dry method is not suitable for this technology due to its more cooling.



优点：催化剂布置在除尘之后，消除了催化剂堵塞和碱金属中毒风险，SCR运行效率高，解决了传统生物质锅炉的SNCR带来的下级省煤器和空预器堵塞问题。

缺点：项目占地大，整体造价稍高，不适于改造项目。

Advantages: Since the catalyst is arranged after the normal temperature dust removal, it does not affect the existing dust removal system, eliminating the risk of catalyst blockage and alkali metal poisoning, meanwhile since SCR has high operation efficiency, it is more stability and reliability.

Disadvantages: The system configuration is complex, the energy consumption of SGH operation is high, and the project area is large. Besides, GGH increases the system resistance, and the overall costs are quite high.

冶金行业 Metallurgical industry

烧结机

Sintering Machine

根据烟气中的SO_2含量（1500-2500mg/Nm^3），脱硫分为湿法、半干法、活性焦脱硫几种技术，相应的除尘器配置也不同，脱硝采用中低温催化剂技术或活性焦技术，根据烟气特点SCR的布置位置不同，配套的换热形式也不同，每个路线均有各自的特点和适应性，常见下述四个工艺路线

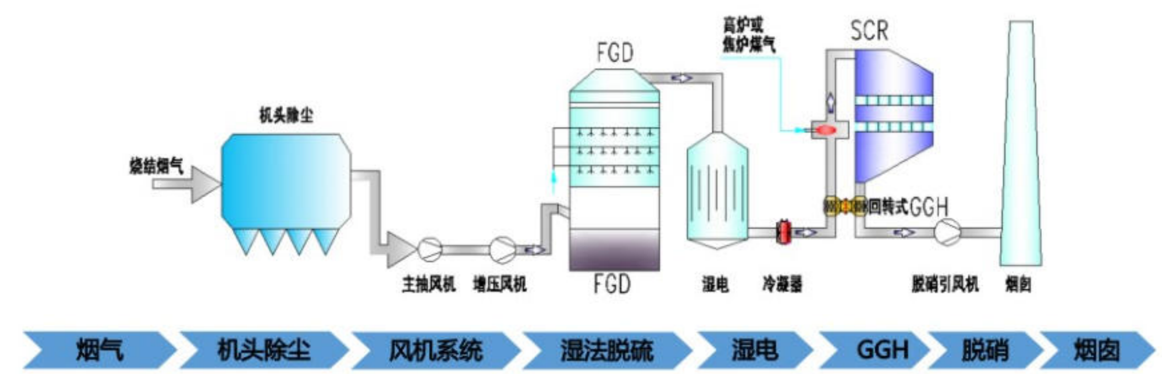
According to the SO_2 content in the flue gas (1500-2500mg/Nm^3), desulfurization is divided into wet method, semi-dry method, active coke desulfurization and other technologies, and the corresponding dust remover configuration is also different. Generally, if using medium and low temperature catalyst technology or active coke technology for denitration, according to the characteristics of flue gas, the SCR layout position is different, the supporting heat transfer form is also different where each route has its own characteristics and adaptability, and the following are four common process routes.

超低排放工艺

Ultra-low emission process

线路一：中温SCR脱硝+湿法脱硫

Route 1:Medium temperature SCR denitration + wet−method desulfurization



烧结烟气 sintering flue gas 机头除尘 dust removal by machine head高炉或焦炉煤气 Blast furnace or coking gas 主抽风机 main exhaust fan 增压风机 booster fan 湿电wet-electricity 烟囱chimney

优点：SCR运行不受烟气中水汽影响，运行温度高，催化剂成本低，可协同脱除二噁英。

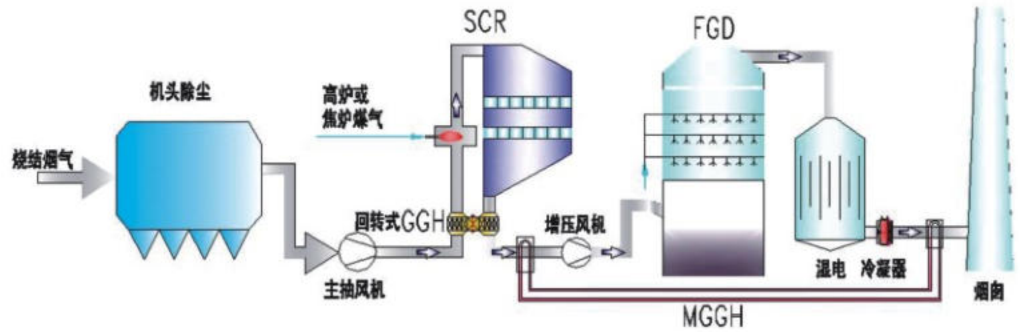
缺点：SCR运行环境高硫，在催化剂作用下易被氧化成SO_3，产生ABS现象，针对烟气消白需设冷凝器及MGGH，系统较复杂。

Advantages: SCR operation is not affected by the water vapor in the flue gas, the operating temperature is high, the catalyst cost is low, and the dioxin can be removed synergistically.

Disadvantages: The SCR operating environment is high in sulfur, which is easily oxidized to SO_3 under the action of the catalyst, resulting in ABS phenomenon. For the smoke whitening, a condenser and MGGH are required, and the system is more complicated.

森源蓝天
SENYUAN LANTIAN

线路二：湿法脱硫+中低温SCR脱硝
Route2:Wet-method desulphurization + medium and low temperature SCR denitration



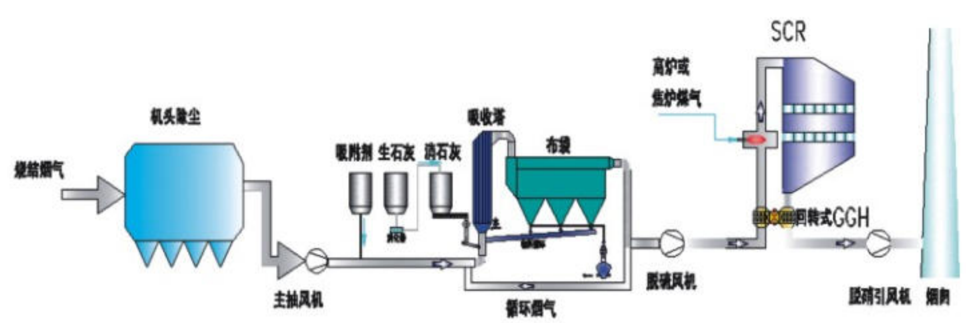
烟气 > 机头除尘 > 主抽风机 > GGH > 脱硝 > 增压风机 > 湿法脱硫 > 湿电 > 烟囱

优点：湿法脱硫可以利旧改造，适合已建湿法脱硫工艺，减少投资，SCR运行在低尘、低硫环境，可减少催化剂设计用量，系统无MGGH，节省投资，可协同脱除二噁英。

缺点：烟气含水率较高，需设置冷凝设备，脱硫烟气夹带的石膏易堵塞GGH。

Advantages: Wet-method desulphurization is greatly benefit to the old material transformation, and is suitable for the established wet-method desulphurization process, reducing the investment. When operating SCR in the environment with low dust and low sulfur, the amount of catalyst design can be reduced and there is no MGGH, saving investment and able to carry out coordinated removal of dioxins.
Disadvantages: There is high water content in the flue gas, leading to it is necessary to arrange condensing equipment, In addition, the entrained gypsum by desulfurization flue gas is easy to block GGH.

线路三：CFB脱硫+中温SCR
Route3:CFB desulphurization + medium temperature SCR denitration



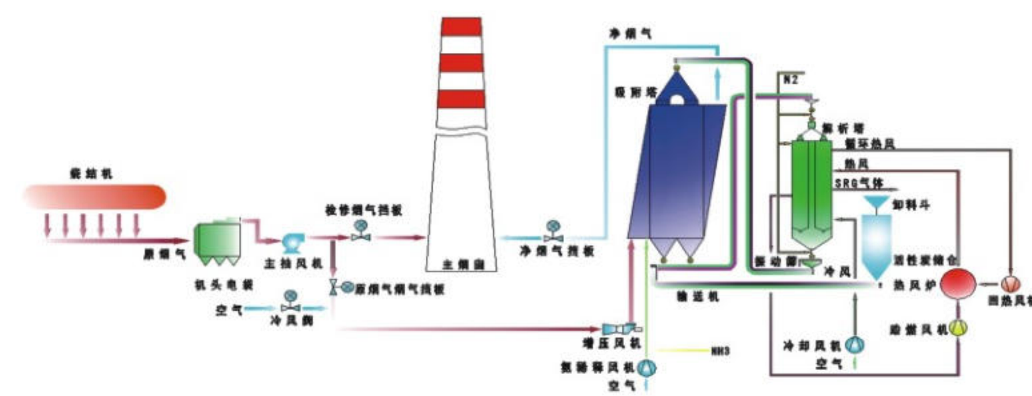
烟气 > 机头除尘 > 主抽风机 > 脱硫系统 > 布袋 > GGH > 脱硝系统 > 烟囱

吸附剂Adsorbent 生石灰quicklime 消石灰slaking lime 吸收塔 absorption tower
引风机 induced draft fan

优点：SCR运行在低尘低硫环境，烟气含水量低，无需冷凝设备，催化剂成本低，协同脱除二噁英。
缺点：系统阻力高，能耗偏大，对运行操作水平要求高，干法脱硫副产物不易处理。

Advantages: SCR is operated in a low dust and low sulfur environment, there is low water content within the flue gas, and it is unnecessary to arrange condensation equipment, resulting in low catalyst costs and able to carry out synergistic removal of dioxins.
Disadvantages: The system resistance is high, the energy consumption is relatively large, there are high requirements for operation level, and the by-products through dry-method desulphurization are difficult to deal with.

线路四：活性焦脱硫脱硝
Route4:Activated coke Desulfurization and denitration



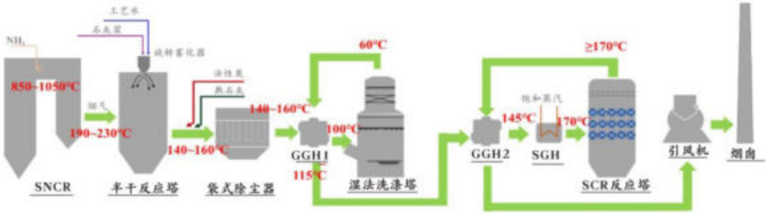
烟气 > 机头电袋 > 主抽风机 > 主烟囱 > 增压风机 > 吸附塔 > 解析塔 > 换热系统

解析塔stripper 冷风阀 cold blast valve 原烟气挡板original flue gas baffle 净烟气挡板 net flue gas baffle
输送机 conveyor 卸料斗discharge hopper 活性炭储仓 activated carbon storage bin

优点：可同时脱硫、脱硝、除尘和脱除重金属，排烟温度高，无烟囱水汽问题，脱硫副产物为经济价值高。
缺点：脱硫效率低，不适于高SO_2场合，投资和运行费用高，活性焦不适于长距离输送。

Advantages: Desulfurization, denitration, dust removal and removal of heavy metals can be carried out at the same time, the exhaust temperature is high, there is no water vapor problem in chimney, and the desulfurization by-products have a high economic value.
Disadvantages: The desulfurization efficiency is low, it is not suitable for the high SO_2 environment, the investment and operation costs are high, and activated coke is not suitable for long distance transportation.

■ 垃圾发电行业
Waste-to-energy industry



工艺路线：SNCR+半干法($Ca(OH)_2$)+干法($Ca(OH)_2$)+活性炭喷射+袋式除尘器+湿法（NaOH）+SCR+洗烟废水处理

系统特点一：垃圾发电行业发展逐渐进入成熟和高发展期，项目运作模式合理，发展前景广阔。

系统特点二：配套的环保设施配置方式较多，随市场需求和淘汰，工艺路线的选择逐渐成熟。

系统特点三：除尘器前的系统采用SNCR+SDA+干法+活性炭技术，尾部预留二级升温深度脱硝空间，系统设备路线短，投资省，运行维护简单。

系统特点四：除尘器后的设备结合各自项目特点配置湿法洗涤塔或中低温脱硝工艺，能满足系统更高的环保排放要求。

System feature 1: the industrial of the power generation is progressively getting in the matured and high developing period, and the operational mode for project is reasonable and it has extensive prospects.

System feature 2: More options come up to match environmental protection facilities configurations. Along with the market requirement and elimination, the options of the artificial routes are progressively matured.

System feature3: the system of ahead of fabric filter adopts SNCR + SDA +dry method and activated carbon technology, with reserving space for deep denitration of secondary temperature rise at the end. And the routes of the system device are short, saving the investment. It has simple maintenance and operation.

System feature 4: the equipment after the precipitator is equipped with wet scrubber or medium and lower temperature denitrification tower according to the characteristics of each project which can meet the higher environmental emission requirement of the system.

■ 建材行业
Building materials industry

技术路径一：适用于低硫烟气（原始$SO_2 \le 500mg/Nm^3$）

单位：mg/Nm^3

	第一阶段				第二阶段		
粉尘	--	--	--	< 10	--	5	5
SO_2	500	500	< 50	--	--	35	35
No_x	< 300	100最小	--	--	50	--	50
其它	--	--	--	协同	协同	协同	--

技术路径二：适用于高硫烟气（原始$SO_2 > 500mg/Nm^3$）

单位：mg/Nm^3

	第一阶段			第二阶段		
粉尘	--	--	--	20	5	5
SO_2	> 500	> 500	> 500	--	35	35
NO_x	< 300	100最小	50	50	50	50
其它	--	--	--	协同	协同	--

系统特点一：非电产能占比较大、大气污染贡献量大户，行业排放控制标准较为宽松，全面实施提标改造势在必行。

系统特点二：脱硝超净技术是行业难点，目前采用的中低温催化还原技术获得应用突破，解决了高尘、磨损等问题。

系统特点三：脱硫结合各自特点可采用半干法工艺或湿法脱硫工艺，技术成熟，各有其适应性和特点。

系统特点四：除尘根据需要前端可采用高温静电除尘满足脱硝需求，后端可采用超净布袋除尘器，满足日益严格的环保标准。

System feature 1:The non-electric production capacity accounts for a large proportion and the contribution of air pollution is large. The emission control standards of the industry are relatively loose, and it is imperative to comprehensively implement the stricter standard and upgrading.

System feature 2: ultra clean technology for denitration is the difficulty in this industry. Currently to adopt the medium and low temperature catalytic reduction technology obtains the great breakthrough. It resolved the problems ofheavy dusts and abrasion.

System feature 3: Combined with their own characteristics, semi dry process or wet process can be adopted for desulftirization, with mature technology and adaptability and characteristics.

System feature 4: according to the needs of the dust removal, the &ont end can use high-temperature ESP to meet the need of denitrification, and the back end may use ultra-cleaning bag filter to meet stricter environmental protection standards.

■ 固废回收
Solid waste recycling

一、冶炼渣的概念及特点

指在各种金属冶炼过程中或冶炼后排出的所有残渣废物。如高炉矿渣、钢渣、各种有色金属渣、铁合金渣以及各种粉尘污泥等

1. The concept and characteristics of smelting slag

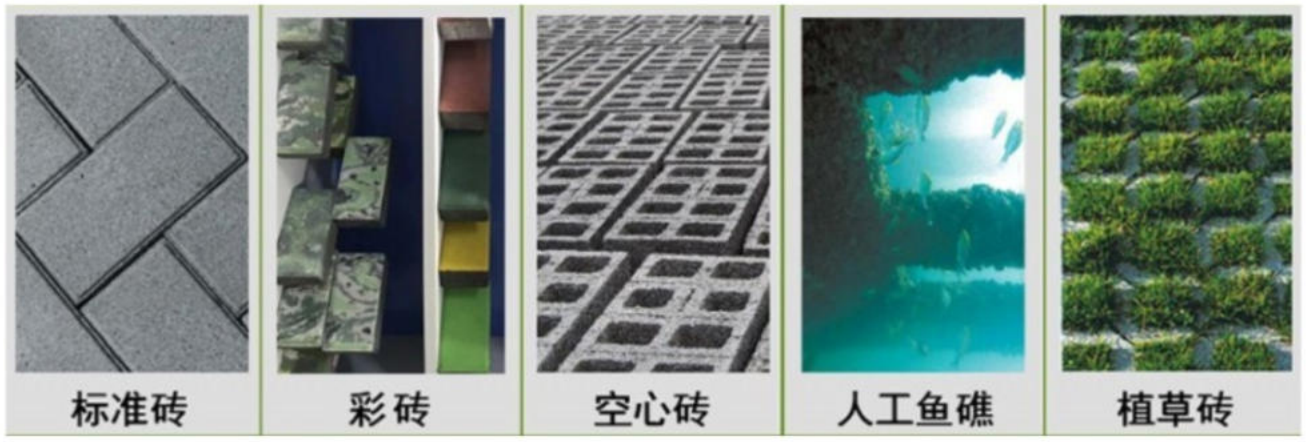
It refers to all the residues and wastes produced during or after the smelting of various metals such as blast furnace slag, steel slag, all kinds of non-ferrous metal slag, ferro-alloy slag and all kinds of dust sludge.

二、冶炼渣的用途

废渣综合利用包括两个主要方面，一是尽可能多地回收渣中的有价金属，这属于炉渣贫化的范畴，提炼贵重金属；二是利用废渣制造各种有用的材料，如生产隔热材料、生产砖瓦、用作筑路材料等。

2. The use of smelting slag

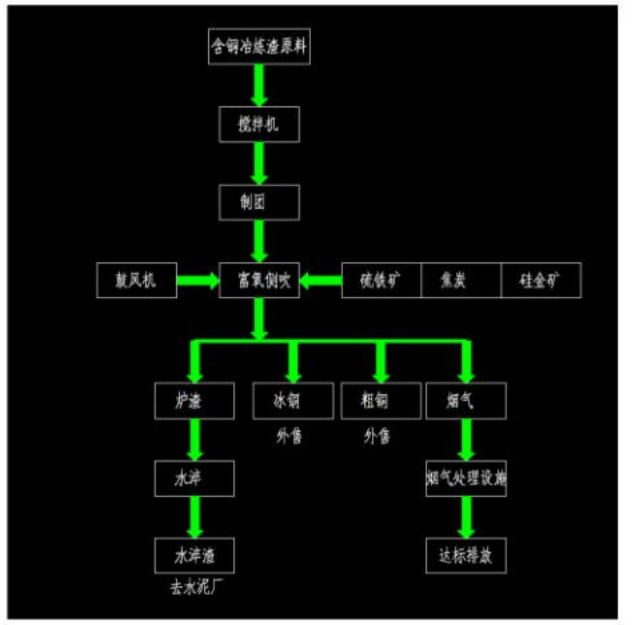
The comprehensive utilization of slag includes two main aspects, where the first one is to recycle valuable metals in slag as much as possible, which belongs to the category of slag dilution, namely refining precious metals and the other one is to use the waste slag to make a variety of useful materials, such as to make road building materials by means of insulation materials and brick and tile materials in production process.



三、处理工艺及路线

3. Treatment process and route

典型含铜废料富氧侧吹还原熔炼工艺
Typical oxygen-enriched side-blow reduction melting process for copper waste



其它典型含重金属冶炼渣处理工艺
Other typical smelting slag treatment process for heavy metals

①钢铁烟尘与有色冶炼废渣协同处理技术
②次氧化锌粉环保脱杂技术
③湿法分离多段耦合提取技术
④废水资源化利用技术
⑤回转窑富氧燃及优化控制技术
⑥回转窑高含锌烟气余热发电技术
⑦回转窑烟气脱硫技术
⑧回转窑还原气氛控制并制取高纯度还原铁粉技术
⑨窑渣选铁尾泥制取环保建材技术
⑩回转窑连续作业防结圈技术

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典型工程案例
ENGINEERING CASE

2*360t/hCFB锅炉烟气治理超净排放改造EPC项目工程
EPC retrofit project for CFB boiler with flue gas treatment for ultra-low emission (2 * 360t / h)


2*440t/h煤粉锅炉烟气治理超净排放改造EPC项目工程
EPC retrofit project for pulverized coal boiler with flue gas treatment for ultra-low emission (2*440t/h)


2*150t/hCFB生物质锅炉发电烟气治理及上料系统EPC项目工程
EPC project for CFB biomass boiler power generation with flue gas treatment for ultra-low emission and feeding system (2*150t/h)


1*140t/h生物质振动炉排锅炉烟气治理超净排放EPC项目工程
EPC project for biomass vibrating grate boiler with flue gas treatment for ultra-low emission (1*140t/h)


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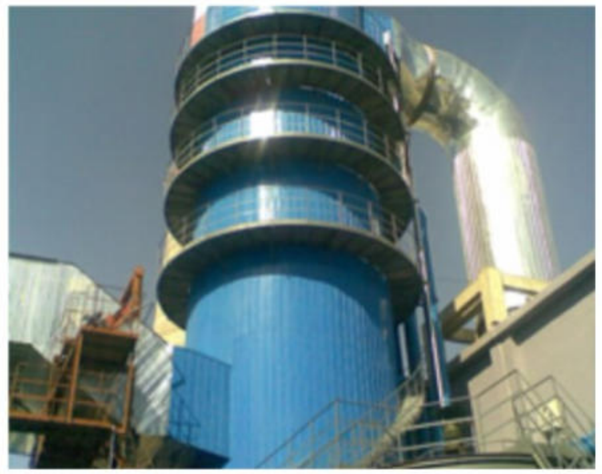
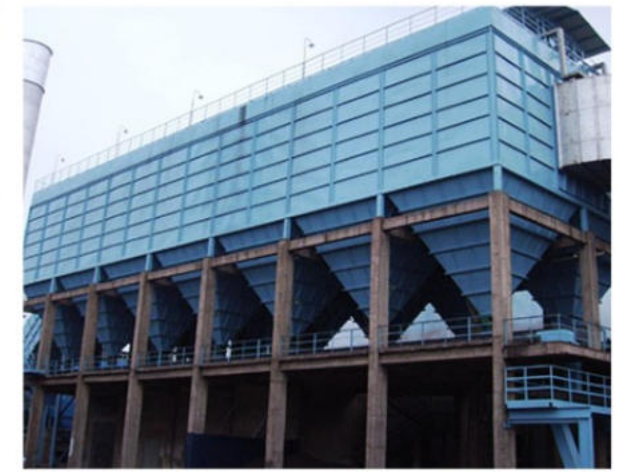
2*600t/d生活垃圾焚烧发电烟气治理EPC项目工程

EPC project for domestic waste incineration power generation with flue gas treatment(2*600t/d)



90吨电炉+ 90吨钢包精炼炉烟气治理超净排放EPC项目

EPC project for 90t electric boiler & 90t ladle refining boiler with flue gas treatment



180m^{2}烧结机烟气治理超低排放EPC项目工程

EPC project for 180m^2 sintering machine with flue gas treatment for ultra-low emission

30MW生物质发电CFB锅炉烟气治理超净排放EPC项目工程

EPC project for 30 MW biomass power generation with flue gas treatment for ultra-low emission

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公司业绩
Performance of SLETC

生物质（秸秆、垃圾）发电行业部分业绩
Part of the customers of theBiomass (straw, garbage) power generation

中国节能环保集团China Energy Conservation and Environmental Protection Group
广西贵糖(集团)股份有限公司GUANGXI GUITANG (GROUP) Co., Ltd
广东长青（集团）股份有限公司Guangdong Chant Group Inc.
韶能集团生物质发电有限公司Shaoneng Group Energy Biomass Power Generation Co.,Ltd.
国能生物发电集团有限公司National Bio Energy Group Co.,Ltd.
康恒环境股份有限公司SUS Environment Co.,Ltd.
凯迪生态环境科技股份有限公司Kaidi Ecological And Environmental Technology Co.,Ltd.
河南省投资集团有限公司Henan Investment Group Co.,Ltd.
中粮集团有限公司COFCO Group Co., Ltd.
山东琦泉集团Shandong Qiquan Energy Group
理昂生态能源股份有限公司Reang Eco-Energy Corp.,Ltd.
长葛市恒光生物质发电有限公司Changge Hengguang Biomass Fuel Co.,Ltd.
恒诚生物质能源综合利用有限公司Hengcheng Biomass Energy Comprehensive Utilization Co.,Ltd.
威立雅环境集团Veolia Environnement
富锦市宸龙生物质热力有限责任公司Fujin City ChengDragon Biomass Heating Power Co.,Ltd.
广西得力木业开发有限公司Guangxi Deli Forestry Development Co.,Ltd.
贵港理昂生物质发电有限公司Guigang Reang Biomass Power Generation Co.,Ltd.
郎溪理昂生物质发电有限公司Langxi Reang Biomass Power Generation Co.,Ltd.
武安通宝新能源有限公司Wu'an Tongbao new energy Co., Ltd
长春市成泰热力有限责任公司Changchun Chengtai Heating Power Co.,Ltd.
水发能源集团有限公司Shuifa Energy Group Co.,Ltd.
江苏联海热电联产有限公司Jiangsu Lianhai Cogeneration Co.,Ltd.
湖北天勤能源有限公司Hubei Legend Power Co.,Ltd.
伊春中基华业能源发展有限公司Yichun Zhongji Huaye Energy Development Co.,Ltd.
海南鲁电生物质发电有限公司Hainan Ludian Biomass Power Generation Co., Ltd

电力行业部分业绩
Part of the customers of the power industry

山西国阳新能发供电厂Shanxi Guoyang Xinneng Power Supply Plant
广东东糖集团三联热电有限公司 Sanlian Thermal Power Co.,Ltd.Of Guangdong Dongtang Group
成都天全化工自备电厂Chengdu Tianquan Chemical Power Plant
贵州凯里电厂Guizhou Kaili Power Plant
广东宝丽华电厂Guangdong Baolihua Power Plant
国电科技股份有限公司Guodian Technology Co.,Ltd.
天津大港区发电FTianjin Dagang District Power Plant
江苏苏源电力工程有限公司Jiangsu Suyuan Power Engineering Co.,Ltd.
吉林西关电厂Jilin Xiguan Power Plant
东风集团第二动力厂Dongfeng Group, The Second Power Plant
齐齐哈尔海阳热力有限公司Qiqiha｢Haiyang Heating Power Co.,Ltd.
林西县热力有限公司Linxi County Heating Power Co.,Ltd.
穆棱市亿阳热电经营有限公司Muling Yiyang Pyroelectricity Operation Co.,Ltd.
成大弘晟能源有限公司Chengda Hongsheng Energy Co.,Ltd.
山东济宁热电有限公司 Shandong Jining Thermoelectric Co.,Ltd.
平顶山坑口电厂Pingdingshan Kengkou Power Plant
济源电厂Jiyuan Power Plant
铁岭天信公用事业集团股份有限公司Tieling Tianxin Public Utilities Limited By Share Ltd.
铁力宇祥热电有限责任公司Tieli Yu Xiang Pyroelectricity Co.,Ltd.
武汉东湖高新热电有限公司Wuhan East Lake High-Tech Thermal Power Co.,Ltd.
湖北襄樊发电有限责任公司Hubei Xiangfan Power Generation Co. Ltd.

建材行业部分业绩
Part of the Building materials industry

葛洲坝水泥有限公司Gezhouba Cement Co.,Ltd.
湖北黄石新世纪水泥有限公司Hubei Huangshi New Century Cement Co.,Ltd.
邢台市水泥厂Xingtai City Cement Industry
湖北世纪新峰雷山水泥有限公司Hubei Century Xinfeng Leishan Cement Co.,Ltd.
广东东莞水泥厂Guangdong Dongguan Cement Plant
华新水泥股份有限公司Huaxin Cement Co.,Ltd.
江西丰城水泥厂Jiangxi Fengcheng Cement Industry
内蒙古川中水泥有限公司Inner Mongolia Chuanzhong Cement Co.,Ltd.
蒲圻华新水泥公司Puxi Huaxin Cement Co.,Ltd.
内蒙古卓子山水泥FInner Mongolia ZhuoZiShan Cement Plant
山西豪洋水泥有限公司Shanxi Haoyang Cement Co.,Ltd.
阳泉天龙工程材料有限公司Yangquan Tianlong Engineering Materials Co.,Ltd.
山西广灵县富成水泥有限公司Shanxi Guangling Fucheng Cement Co.,Ltd.
山西石工水泥有限责任公司Shanxi Stone Industry Cement Co.,Ltd.
重庆金江水泥有限公司Chongqing Jinjiang Cement Co.,Ltd.
湖北竹山康华水泥有限公司Hubei Zhushan Kanghua Cement Co.,Ltd.
重庆武隆长欣水泥有限公司Chongqing Wulong Changxin Cement Co.,Ltd.
新疆天山水泥有限公司Xinjiang Tianshan Cement Co.,Ltd.
武汉长利新材料科技股份有限公司Wuhan Changli New Material Technology Co., Ltd

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钢铁、冶金、焦化行业部分业绩
Part of the customers of the Iron and steel metallurgy industry

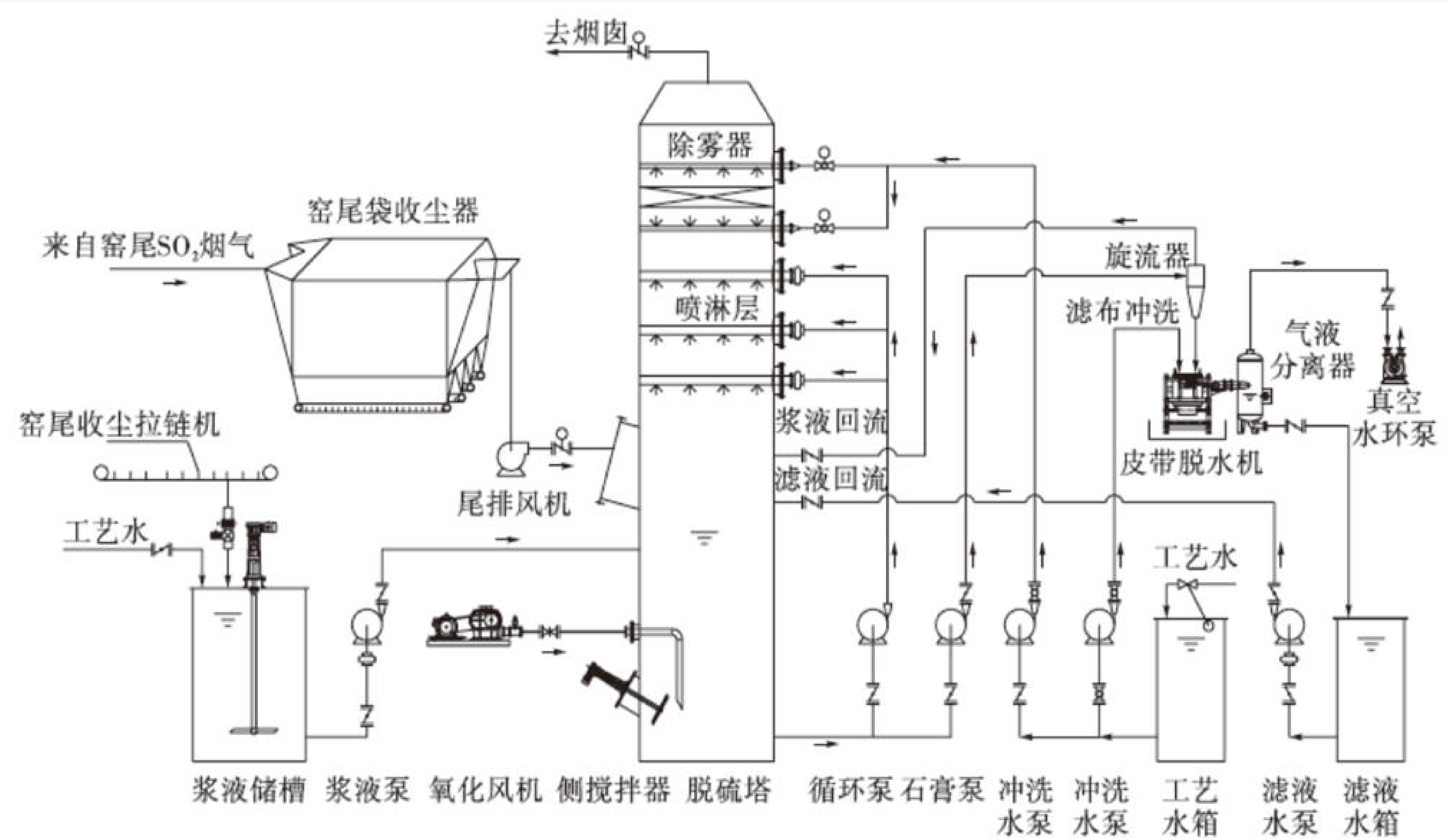
武汉钢铁公司Wuhan Iron And Steel (Group) Co.,Ltd.
武钢大冶铁矿球团厂Wugang Daye Iron Ore Pellet Plant
福建三宝钢铁有限公司 Fujian SanBao Iron And Steel Co.,Ltd.
大冶华鑫钢铁有限公司Daye Huaxin Iron Co.,Ltd.
大冶灵成钢铁有限责任公司Daye lingcheng Iron And Steel Co.,Ltd.
大冶市盛冶矿业有限公司Daye City Shengzhi Mining Industry Co.,Ltd.
济源钢铁(集团)有限公司 Jiyuan Iron And Steel (Group)Co.,Ltd.
贵州水城钢铁有限公司Guizhou Shuicheng Iron And Steel Co.,Ltd.
河北神帮矿业有限公司Hebei Shenbang Mining Co.,Ltd.
大冶特殊钢有限公司Daye City Shengyei Mining Industry Co.,Ltd.
安徽鑫源铸业有限公司Anhui Xinyuan Casting Industry Co.,Ltd.
首钢矿业有限公司Shougang Mining Co.,Ltd.
新余峰泰矿业有限公司New Yufeng Tai Mining Co.,Ltd.
新余劳动服务公司球团FXinyu Labor Service Pellet Plant
云南德胜钢铁有限公司Yunnan Desheng－Iron And Steel Co.,Ltd.
云南玉溪红山球团工贸有限公司Yunnan Yuxi Hongshan Pelletizing Industry &Trade Co.,Ltd.
宣化钢铁集团责任有限公司Xuanhua Iron & Steel Group Co.,Ltd.
四川攀枝花中禾矿业有限公司Sichun Panzhihua Zhonghe Mining Co.,Ltd.
武汉远方钢铁有限公司Wuhan Yuanfang Iron And Steel Co.,Ltd.
济源钢铁股份有限公司Jiyuan Iron And Steel Group Co.,Ltd.
河北钢铁股份有限公司Hebei Iron And Steel Group Co.,Ltd.
安阳钢铁股份有限公司Anyang Iron And Steel Group Co.,Ltd.
唐山钢铁有限公司Tangshan Iron And Steel Co.,Ltd.
秦皇岛安丰钢铁有限公司Qinhuangdao Anfeng Steel Co.,Ltd.
山东淄博蟠龙山钢铁有限公司Shandong Zibo Panlongshan Iron And Steel Co.,Ltd.
山东富伦钢铁公司Shandong Fulun Iron And Steel Co.,Ltd.
甘肃酒钢集团宏兴钢铁股份有限公司Gansu Jiu Steel Group Hongxing Iron & Steel Co.,Ltd.
承钢集团Chenggang Group
山东容芜钢铁股份公司炼钢厂Shandong Rongwu Iron And Steel Co.,Ltd.Steelmaking Plant
酒钢集团公司翼钢公司Yisteel Company Of Jiugang Group
唐山鼎新钢铁有限公司Tangshan Dingxin Iron And Steel Co.,Ltd.
灵丘金宇铁合金有限责任公司Lingqiu Jinyu Ferroalloy Co.,Ltd.
山西省原平市晋宇实业有限公司Shanxi Yuanping Jinyu Industry Co.,Ltd.
大冶市新冶特钢有限责任公司Daye Xinye Special Steel Co.,Ltd.
山西大土河焦化有限责任公司Shanxi Datuhe Coking Co.,Ltd.

固废行业
Solid waste industry

北京高能时代环境技术股份有限公司Beijing high energy times Environmental Technology Co.,Ltd.
中国黄金集团有限公司China Nationai Gold Group Co.,Ltd.
中国再生资源开发有限公司China renewable resources development Co.,Ltd.
广西有色金属有限公司Guangxi nonferrous metal Co.,Ltd.
萍乡市冶金有限公司Pingxiang metallurgy Co.,Ltd.

国外部分客户
Some foreign customers

印度伊斯帕特钢铁厂India Ispat Steel Plant
孟加拉阿诺瓦水泥厂Bangladesh La Nova Cement Plant
巴基斯坦依沙水泥厂Pakistan Isa Cement Factory
以色列FS化工厂Israel FS Chemical Plant
伊朗法斯诺水泥厂Iran's Cement Plant
越南30万吨水泥项目Vietnam 300000 Tons Of Cement Project
越南西贡协福水泥粉磨站Saigon Xiefu Cement Grinding Station
印度120万吨球团厂项目India 1.2 Million Tons Pellet Plant Project



· ⁄¸† SO2 ˘ł ¡œ Flue gas from kiln tail SO2
⁄¸†˚‡˘ ¡œ Kiln tail dust collector
⁄¸†˚‡ ›`·»œ ¡œ Kiln tail dust collector zipper conveyor
„⁄ ¸fi ¡œ Process water
‰‹ ”·¢† ¡œ Slurry storage tank
‰‹ ”–ˆ¡œ Slurry pump
ı»fl• »œ ¡œ Oxidation blower
†‰` Ł˘ ¡œ Side agitator
˝` ¡œ Desulfurization tower
¨` †ª ¡œ Spray layer
‡¸˘ ¡œ Mist eliminator
˜¥· ¡œ To chimney
¸†¯• »œ ¡œ Tail exhaust fan
‰‹ ”» ` ¡œ Slurry return
´¸”» ` ¸. ¡œ Filtrate return
›»•–ˆ‹ ¡œ Circulation pump
˚fl‚–ˆ ¡œ Gypsum pump
—`˘ ¡œ Hydrocyclone
´¸†…‡˘· ¡œ Filter cloth washing
˘⁄ł˝¸fi»œ ¡œ Belt dewatering machine
˘ł”•˚º˘ ¡œ Gas-liquid separator
¿¸fi»•–ˆ ¡œ Vacuum liquid ring pump
‡˚·¸fi–ˆ ¡œ Wash water pump
„⁄ ¸fiˇ ¡œ Process water tank
´¸”¸fi–ˆ ¡œ Filtrate pump
´¸”¸fiˇ ¡œ Filtrate water tank

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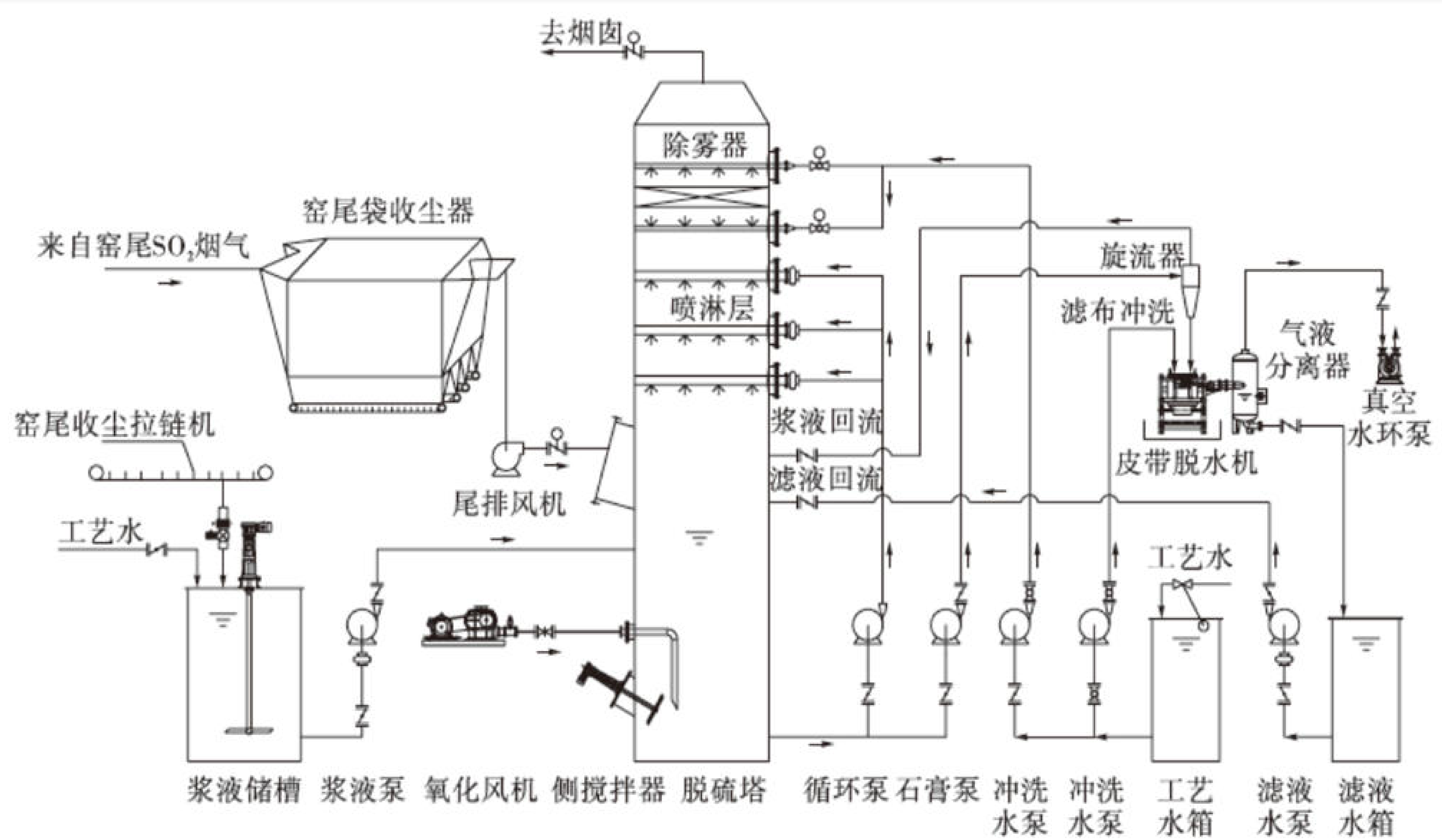

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诚信铸就品质，创新引领未来!
Integrity creates quality and innovation leads the future!

武汉森源蓝天环境科技工程有限公司
Wuhan Senyuan Lantian Environmental Technology Engineering Co.,Ltd.

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