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NARI GROUP CORPORATION

北京国电富通科技发展有限公司
BEIJING GUODIAN FUTONG SCIENCE AND TECHNOLOGY DEVELOPMENT CO.,LTD.



Air-cooling Steel Belt Dry Bottom Ash Handling System For Coal Fired Boilers

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Beijing Guodian Futong Science and Technology Development Co., LTD was founded in November 2002, and was registered Fengtai park of Beijing Zhongguancun National Independent Innovation Demonstration Area, with registered capital of 150 million RMB. It is a wholly-owned subsidiary of State Grid Electric Power Research Institute (Nari Group), one of the enterprises directly under the State Grid Corporation. It has an area of about 31,500 square meters for production base, and 5,200 square meters for office space. There are 477(including 151 productive labor dispatch staffs) staffs total in company, of whom are 6 doctors, 79 post graduates, 146 under graduate, 4 senior engineers with professor title, 39 senior engineers, 79 engineers, 53 assistant engineers. It has 9 business departments (Piping and fittings branch,

Mechanical conveying department, Pneumatic conveying department, Water treatment department, Equipment manufacturing center, Sales & Marketing Center, Marketing Department, After-sales service department and Research & Development department) and 6 functional departments (General management department, Party work department, Human resource department, Financial assets department, Development planning department, Materials management department).

Using its substantial high-tech experience, the company mainly focuses on working for the technology research and development, product selling, equipment completion and EPC project for energy efficiency, water conservation, environmental protection, high pressure and high temperature pipefitting, recycling and renewable resources, clean coal technology, distribution automation of power grids etc. Its products have been sold well domestic and entered the International market.

At present, the company has 5 major products, which include: Large Diameter High Temperature and High Pressure Pipefitting, Dry Bottom Ash Handling System for Coal Fired Boiler, Fly Ash Dense Phase Pneumatic Conveying Systems (DTS[®]), Pipe Conveyor System, and Bio-membrance fluidized waste water treatment system. Especially, HT & HP Pipefitting and Dry Bottom Ash Handling System are in the leading position all over the world, not only break the monopoly of foreign Company but also share the first place in domestic market. The company developed and industrialization promoted several products, like Lignite Upgrading and Comprehensive Utilization Technology, Coal Chemical Waste Water Treatment Technology, Organic and Inorganic Hybrid Nanometer RTV Coating Technology, Closed Water Cooling System of DC Converter Valves. All products are initiative domestically and fill the blank in China and reach the international advanced level.

Meanwhile, the company has passed the ISO 9001:2008 quality management systems certificate, ISO 14001:2004 environmental management systems certificate, GB/T 28001-2001 occupational health and safety management systems certificate, and has awarded the manufacture license of special equipment (pressure pipelines and pressure vessels) of People's Republic of China, ASME U stamp for pressure vessels and PP stamp for power pipelines (associated with NB certificate), the state environmental protection project specialized in contracting qualification certificate and B Level environmental engineering (water pollution prevention engineering) specialized in design qualification certificate; AAA financial credit level, and also has the right to import and export products and technologies.

Beijing Guodian Futong Science and Technology Development Co., Ltd. peruses excellence by striving to exceed expectations. The company has devoted itself in innovation, contribution and hard work. The company follows specific principles: Technical innovation, top quality, effective management, sincerity and honesty. The company is striving to develop by vigorous innovations and realize win-win situation by effective cooperation. The company's mission is to realize the self-development of its staff, to provide satisfy and high-tech products for customers, and to do some contribution to a harmonious society.

Dry Bottom Ash Handling Technology

Traditional wet bottom ash handling system is the common technology used by coal fired boilers for many years. Although it was in continuous improvement, but still has following problems to solve:

- 1 High water and power consumption
- 2 High unburned carbon residue and poor activity
- 3 Low comprehensive value of utilization
- 4 Not benefit to boiler efficiency improvement
- 5 Complicated system configuration, large area occupation
- 6 High operation and maintenance cost
- 7 High potential dangerous to operators (vapor explosion)
- 8 All heat of bottom ash was completely lost in water
- 9 Radiation heat loss in the area of boiler throat
- 10 Bottom ash drops into the water and the vapor produce the corrosion to the water tubes of boiler throat

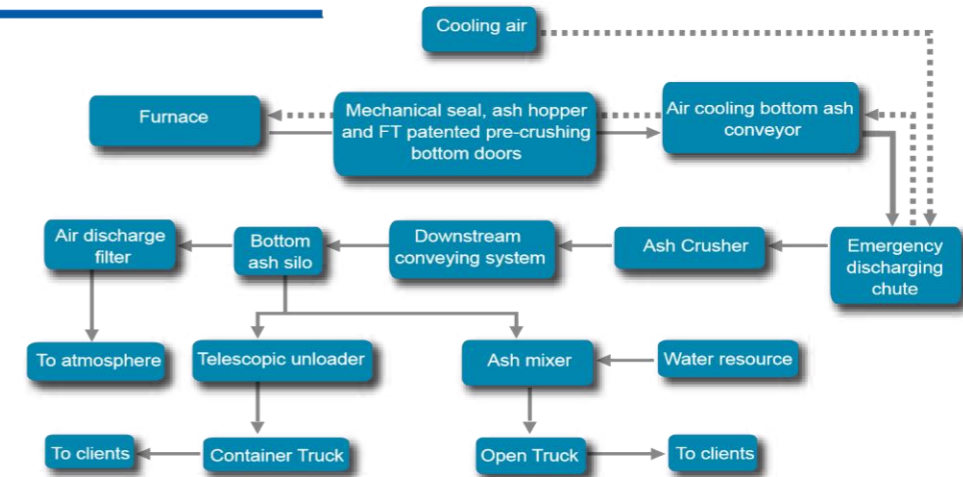


In the late 1980s, dry bottom ash handling system started to be applied in the industrial developed countries, but only for the units under 100MW. Then gradually developed and applied to 300MW, 350MW, 600MW and 1000MW. Dry bottom ash handling system can solve the problems of wet one, and have following advantages:

- 1 No water consumption, and equipped with pneumatic ash conveying system, it will create the conditions for zero emissions.
- 2 Unburned materials in the ash can continue burning. The generated heat can be returned to furnace so as to reduce the incomplete combustion and physical heat losses of boiler and to increase boiler efficiency.
- 3 Sufficient combustion of bottom ash, unburned carbon content decreased, while maintaining the ash activity without water to increase the value of comprehensive utilization of bottom ash.
- 4 Compared with traditional wet bottom ash handling systems, dry one is a simpler system with low accident rate, save area and reduce the operation (water, electricity, labor, maintenance, etc.) and maintenance cost.
- 5 The system adopts industrial computer control system with higher degree of automation, to improve the reliability of the bottom ash handling system.
- 6 Pulverized dry bottom ash can be directly transported to the fly ash silo by pneumatic conveying system in order to increase value of comprehensive utilization.
- 7 The system will not increase investment for new power plants. For the retrofit units, due to the reduction of operation and maintenance cost and the value-added benefits generated by bottom ash, normally the investment will be recovered within 3 years.



System Flow Chart



Technical Features

- 1 Clinker crusher (Futong patented precrushing bottom doors) is the key equipment of the system, installed between the ash hopper and steel belt ash conveyor. It can prevent influence on the super steel belt from furnace radiation and to reduce heat load, and impact on the super steel belt from large clinkers to ensure safety operation. And it has cooling function to reduce heat load onto the super steel belt.
- 2 Steel belt bottom ash conveyor is the key equipment of the system and its function is continuous receiving and conveying hot bottom ash. In the process of conveying, bottom ash can be further burnt and cooled. Steel belt ash conveyor consists of high temperature resistant conveying belt, shell, driving unit and tensioning device etc. and can meet the requirements of high temperature and high dust working condition. The average service life of super steel belt is more than 10 years. Under the conveying belt, there is a cleaning chain to clean fine ash accumulated on the bottom of the conveyor.
- 3 Ash crushers are to crush bottom ash to proper particle size which can meet the requirements of downstream conveying system and can be further cooled down. According to different types of downstream conveying system, various crushers, such as primary and secondary crushers, are available.
- 4 The downstream conveying system is to convey the bottom ash, which is discharged from upstream steel belt conveyor, and passes through the crushing equipment, to the bottom ash silo or fly ash silo. Based on the requirement of each power plant, Futong can design various types of downstream conveying systems, such as the mechanical conveying, positive pressure conveying, and negative pressure conveying systems.
- 5 The bottom ash silo is to store bottom ash temporarily inside the plant. And discharging equipments are to discharge bottom ash into open or closed truck to outside plant, or by long-distance conveying equipment, such as rubber belt conveyor etc. to the ash silo.
- 6 The whole system adopts industrial computer automatic control, to conduct real-time data acquisition and processing, operation status supervision and process control. The malfunction signals monitored can be saved, and alarm automatically, to ensure safety operation of the bottom ash handling system. Control system can be set into three modes, automatic, manual, and maintenance. It is with higher automation degree and more convenient maintenance





Working Principle

In normal operation of boiler, the bottom ash (around 900℃) falls down onto the steel belt conveyor through ash hopper and clinker crusher (i.e. Futong patented pre-crushing bottom doors). The steel belt conveyor works at low speed and conveys bottom ash to ash crusher for size reducing. Smaller size bottom ash is discharged to downstream conveying system and then to bottom ash silo. In the whole conveying and discharging process, the bottom ash can be cooled down to lower than 120℃ which can meet the requirements of storage. The bottom ash in silo can be delivered via discharging equipments based on clients' requirements.

Inside the steel belt conveyor, a certain amount of ambient air is sucked thanks to slight negative pressure of furnace to cool the bottom ash during its conveying on the steel belt conveyor. The unburned carbon inside bottom ash can further burn on super steel belt. In this cooling and re-burnt process, the heat exchange can be done between cooling air and high temperature bottom ash. After heat exchange, temperature of cooling air increases to 300 – 400℃, which is equivalent to temperature of secondary air, while the bottom ash can be cooled down to lower than 120℃. The amount of cooling air is well controlled within 1% of total combustion air of boiler. Based on our rich engineering experience and boiler performance test by relevant authoritative electric power research institute, the cooling air after heat exchange enters to the furnace. It has not any adverse influence on boiler combustion and performance, but helps to improve boiler efficiency.

Main Technical Parameters

The main technical parameters of the dry bottom ash handling system can be designed based on the technical datum, such as boiler parameters, fuel parameters, layout requirements, in order to achieve economic operation of the system.

Item	Parameters
Ash conveying capability	4.0 – 70.0 t/h
Bottom ash temperature	≤900℃
Final bottom ash temperature	≤120℃
The amount of cooling air	Normally less than 1% of the total boiler combustion air
Conveying distance	≤1500m
Expected service life of Futong super steel belt	More than 10 years
I & C system	Profibus technology

Range of Application

Futong dry bottom ash handling system has been applied to handle bottom ash of 25 MW– 1000MW coal fired boilers as well as fluidized bed boilers.

Application cases

1 Downstream Mechanical Conveying System

Dry bottom ash handling system of Figure 1 can be applied to 25MW – 1000MW coal fired boilers, with the conveying distance of less than 100m.

1.Boiler 2. Mechanical seal 3. Bottom ash hopper 4. Clinker crusher (Futong patented pre-crushing bottom doors) 5. Futong first steel belt conveyor 6. Hydraulic unit 7. Ash crusher 8. Intermediate ash hopper 9. Ash feeder 10. Secondary steel belt conveyor 11. Bag filter 12. Bottom ash silo 13. Vibrators 14. Ash feeder 15. Metering device 16. Ash unloader 17. Ash truck 18. E & C system



3 Downstream pressurized pneumatic conveying system

Dry bottom ash handling system of Figure 3 can be applied to 25MW – 1000MW coal fired boilers, with the conveying distance of less than 1000m.

1.Boiler 2. Bottom ash hopper 3. Clinker crusher (Futong patented pre-crushing bottom doors) 4. Futong steel belt conveyor 5. Hydraulic unit 6. Intermediate ash hopper 7. Ash crusher 8. Ash intake valve 9. Ash feeder 10. Ash transmitting vessel 11 Air compressor 12. Air tank 13. Pressurized pneumatic ash conveying pipeline 14. Vacuum pressure relief valve 15. Bag filter 16. Bottom ash silo 17. Vibrators 18. Ash feeder 20. Ash truck 21. E & C system



2 Downstream vacuum pneumatic conveying system

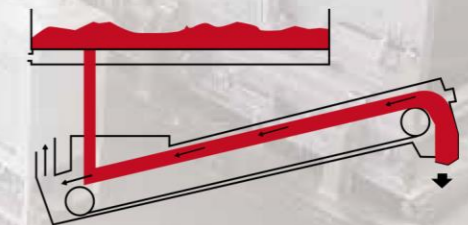
Dry bottom ash handling system of Figure 2 can be applied to 25MW – 1000MW coal fired boilers, with the conveying distance of less than 200m.

1.Boiler 2. Mechanical seal 3. Bottom ash hopper 4. Clinker crusher (Futong patented pre-crushing bottom doors) 5. Futong steel belt conveyor 6. Hydraulic unit 7. Ash crusher 8. Intermediate ash hopper 9. Ash feeder 10. Air inlet 13. Vacuum pneumatic ash conveying pipeline 15. Bag filter 16. Buffer hopper 17. Bottom ash silo 18. Vibrators 19. Ash mixer 20. Rubber belt conveyor 21. Ash feeder 22. Metering device 23. Ash unloader 24. Ash truck 25. E & C system



4 Application in circulating fluidized bed boiler

Figure 4 shows the dry bottom ash handling system for circulating fluidized bed boiler. The difference with coal fired boiler is the cooling method. The pressure of the furnace of the circulating fluidized bed boiler is positive. The cooling air is supplied by air blower. After cooling process, the hot air mixes with secondary air, and then enters into furnace together with secondary air.

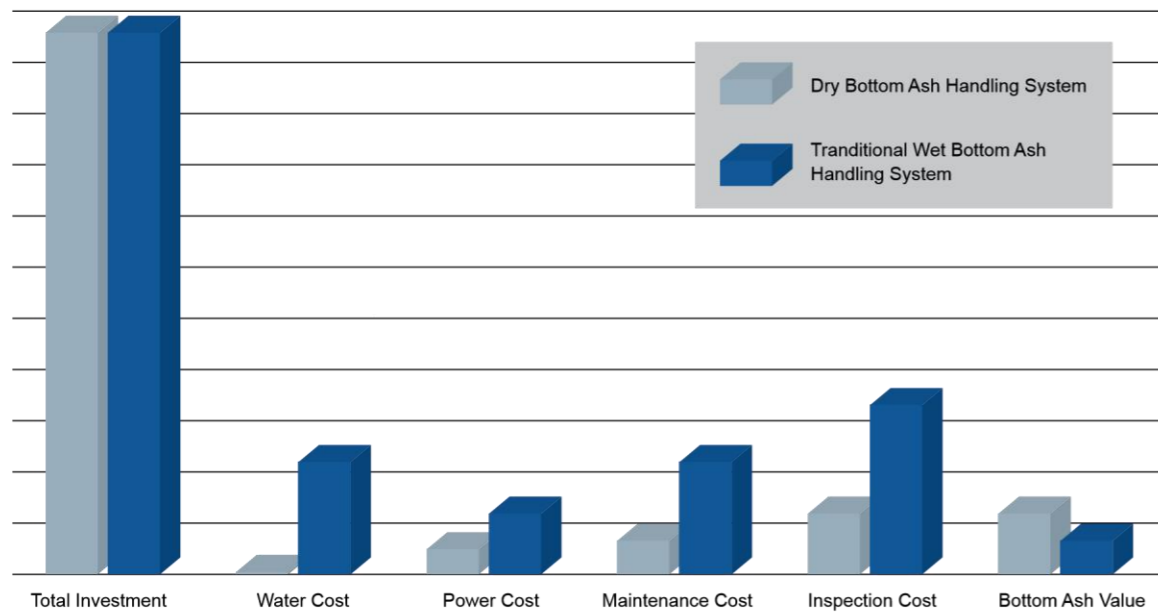


Main Equipments



Economic Analysis

Economic analysis between dry bottom ash and traditional wet bottom ash handling systems (2×300MW)



Patents and Awards



Typical Reference Power Plant



Part of The Reference List of Futong Dry Bottom Ash Handling System for Coal Fired Power Station

Until May, 2011, Futong has 213 reference power stations, including 24 sets of 1000MW units, 88 sets of 600-680MW units, 65 sets of 300MW-350MW units, and 36 sets of 200MW or smaller than 200MW units. Particularly, Futong has rich experience on overseas projects, such as Indonesia PLTU 2 BANTEN- LABUAN 2x300MW Power Plant, Indonesia Pacitan 2x (300~400) MW Power Plant, Indonesia PLTU 3 3X315MW BANTEN, Indonesian Muiyin 2x150MW Power Plant, Indonesia Geely Puddo 2X125MW Power Plant, Turkey Atlas Iskenderun 2x600MW Power Plant, Australia Muja 2X227MW Power Plant, and Russia Troitsk 2x660MW Power Plant.

No.	Project	Capacity	System Output	System Configuration
I . 1000MW UNIT (22 sets)				
1	Tianjing Beijiang PP. #1	1000MW	25-45 t/h	Two stage steel belt conveyor + Bucket Elevator + silo
2	Tianjing Beijiang PP. #2	1000MW	25-45 t/h	Two stage steel belt conveyor + Bucket Elevator + silo
3	Guohua Suizhong PP. #3	1000MW	10-30 t/h	Two stage steel belt conveyor + Bucket Elevator + silo
4	Guohua Suizhong PP. #4	1000MW	10-30 t/h	Two stage steel belt conveyor + Bucket Elevator + silo
5	Shandong Laizhou PP. #1	1000MW	10-30 t/h	Two stage steel belt conveyor + Bucket Elevator + silo
6	Shandong Laizhou PP. #2	1000MW	10-30 t/h	Two stage steel belt conveyor + Bucket Elevator + silo
7	Huadian Wuhu Phase II PP. #3	1000MW	20-45 t/h	Two stage steel belt conveyor + Bucket Elevator + silo
8	Huadian Wuhu Phase II PP. #4	1000MW	20-45 t/h	Two stage steel belt conveyor + Bucket Elevator + silo
9	Henan Pingdingshan 2nd PP. #1	1000MW	20-58 t/h	One stage steel belt conveyor + Bucket Elevator + silo
10	Henan Pingdingshan 2nd PP. #2	1000MW	20-58 t/h	One stage steel belt conveyor + Bucket Elevator + silo
11	Guohua Xuzhou Power Plant #1 unit	1000MW	20-58 t/h	Two stage steel belt conveyor + silo
12	Guohua Xuzhou Power Plant #2 unit	1000MW	20-58 t/h	Two stage steel belt conveyor + silo
13	Huaneng Nantong Power plant #5 Unit	1000MW	15-40t/h	Two stage steel belt conveyor + silo
14	Huaneng Nantong Power plant #6 Unit	1000MW	15-40t/h	Two stage steel belt conveyor + silo
II . 660MW 600MW Unit (88 sets)				
15	Xuzhou Kanshan PP. 1#	660MW	11-44 t/h	Two stage steel belt conveyor + silo
16	Xuzhou Kanshan PP. 2#	660MW	11-44 t/h	Two stage steel belt conveyor + silo
17	Huaneng Yimin PP. 3#	600MW	16-38 t/h	One stage steel belt conveyor + Pressure Conveying + silo
18	Huaneng Yimin PP. 4#	600MW	16-38 t/h	One stage steel belt conveyor + Pressure Conveying + silo
19	1st stage of Huaneng Shanxi Tongchuan PP. 1#	600MW	10-20 t/h	Two stage steel belt conveyor + silo
20	1st stage of Huaneng Shanxi Tongchuan PP. 2#	600MW	10-20 t/h	Two stage steel belt conveyor + silo
21	1st stage of Huaneng Anhui Chaohu PP. 1#	600MW	13-32 t/h	One stage steel belt conveyor + Chain Bucket Elevator + silo

No.	Project	Capacity	System Output	System Configuration
22	1st stage of Huaneng Anhui Chaohu PP. 2#	600MW	13-32 t/h	One stage steel belt conveyor + Chain Bucket Elevator + silo
23	Henan Qinbei PP. 1#	600MW	10-20 t/h	One stage steel belt conveyor + Chain Bucket Elevator + silo
24	Henan Qinbei PP. 2#	600MW	10-20 t/h	One stage steel belt conveyor + Chain Bucket Elevator + silo
25	Hebei Shang'an PP. 5#	600MW	17-44 t/h	One stage steel belt conveyor + Bucket Elevator + silo
26	Hebei Shang'an PP. 6#	600MW	17-44 t/h	One stage steel belt conveyor + Bucket Elevator + silo
27	Shanxi Zhaoguang PP. #3	600MW	35-65 t/h	One stage steel belt conveyor + Chain Bucket Elevator + silo
28	Shanxi Zhaoguang PP. #4	600MW	35-65 t/h	One stage steel belt conveyor + Chain Bucket Elevator + silo
29	Shandong Rizhao PP. #3	680MW	13-39 t/h	One stage steel belt conveyor + Chain Bucket Elevator + silo
30	Shandong Rizhao PP. #4	680MW	13-39 t/h	One stage steel belt conveyor + Chain Bucket Elevator + silo
31	Shanghai Wangting PP. #1	660MW	11-46 t/h	One stage steel belt conveyor + Bucket Elevator + silo
32	Shanghai Wangting PP. #2	660MW	11-46 t/h	One stage steel belt conveyor + Bucket Elevator + silo
33	Hebei Cangdong PP. #3	660MW	10-25 t/h	One stage steel belt conveyor + Bucket Elevator + silo
34	Hebei Cangdong PP. #4	660MW	10-25 t/h	One stage steel belt conveyor + Bucket Elevator + silo
35	Daban PP. #1	600MW	10-40 t/h	One stage steel belt conveyor + Bucket Elevator + silo
36	Daban PP. #2	600MW	10-40 t/h	One stage steel belt conveyor + Bucket Elevator + silo
III . Overseas project (17 sets)				
37	Turkey Atlas Iskenderun Power Plant #1 unit	600MW	5-20 t/h	One stage steel belt conveyor + Bucket Elevator + silo
38	Turkey Atlas Iskenderun Power Plant #2 unit	600MW	5-20 t/h	One stage steel belt conveyor + Bucket Elevator + silo
39	Russia Troitsk PP Unit 1#	660 MW	28-40 t/h	One stage steel belt conveyor + Pressure Conveying + silo
40	Russia Troitsk PP Unit 2#	660 MW	28-40 t/h	One stage steel belt conveyor + Pressure Conveying + silo
41	Indonesia PLTU 2 BANTEN- LABUAN Power Plant #1	300MW	5-10 t/h	One stage steel belt conveyor + Bucket Elevator + silo
42	Indonesia PLTU 2 BANTEN- LABUAN	300MW	5-10 t/h	One stage steel belt conveyor + Bucket Elevator + silo
43	Indonesia PLTU 3 BANTEN #1	300MW	5-10 t/h	One stage steel belt conveyor + Bucket Elevator + silo
44	Indonesia PLTU 3 BANTEN #2	300MW	5-10 t/h	One stage steel belt conveyor + Bucket Elevator + silo
45	Indonesia PLTU 3 BANTEN #3	300MW	5-10 t/h	One stage steel belt conveyor + Bucket Elevator + silo
46	Indonesia Pacitan Power Plant #1	300MW	5-10 t/h	One stage steel belt conveyor + Bucket Elevator + silo
47	Indonesia Pacitan Power Plant #2	300MW	5-10 t/h	One stage steel belt conveyor + Bucket Elevator + silo
48	Australia Muja PP #7	227MW	1.4-10 t/h	One stage steel belt conveyor + silo
49	Australia Muja PP #8	227MW	1.4-10 t/h	One stage steel belt conveyor + silo
50	Guohua Indonesian Muiyin Project #1 unit	150MW	1.1-3 t/h	One stage steel belt conveyor + Bucket Elevator + silo
51	Guohua Indonesian Muiyin Project # 2 unit	150MW	1.1-3 t/h	One stage steel belt conveyor + Bucket Elevator + silo
52	Indonesia Geely Puddo #1	125MW	3-10 t/h	One stage steel belt conveyor + Bucket Elevator + silo
53	Indonesia Geely Puddo #2	125MW	3-10 t/h	One stage steel belt conveyor + Bucket Elevator + silo





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