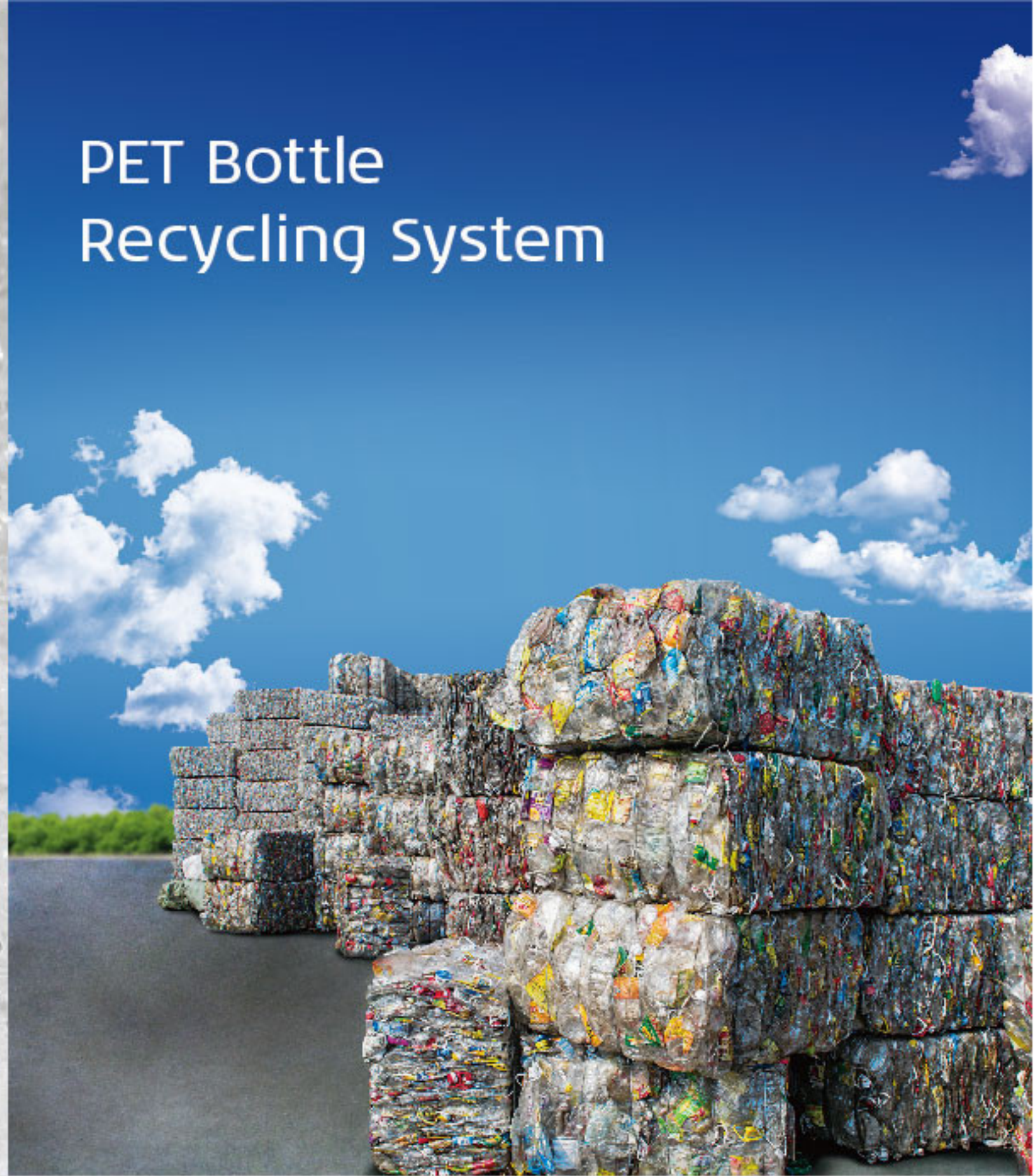




PET Bottle Recycling System



Boretech Co., Ltd.
No. 888, Jiuliting Avenue, Caoqiao Street,
Pinghu City, Zhejiang, China.
T: +86-573-8512-0186 F: +86-573-8511-3959
E-mail: sales@bo-re-tech.com



Resources and Technology Integrator of
Recycled Polyester Industrial Chain

www.bo-re-tech.com

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Boretech Brief

BORETECH is a professional environmental mechanical engineering company which specializes in the recycling of PET bottle and production of polyester. Started as a PET bottle recycling factory in Taiwan in 1991, Boretech enters into the production of regenerated polyester fibers in 1994. After 10 years of work, Boretech has accumulated a wealth of expertise in PET bottle materials; by virtue of the understanding on the production raw materials and quality requirements of the regenerated polyester, through continuous research and innovation, we had launched into the new business of manufacturing of PET bottle washing line. Up to now, we has achieved "the PET bottle washing line with the single line capacity of 6 tons /hour , the world's largest capacity of a single line and B-to-B grade turnkey project" , and to provide it to the first batch of national "Urban

mineral demonstration base industrial park" . Sewage treatment engineering, pipeline engineering, automatic control and other complete sets of professional engineering planning, those of which total solution service, effectively and completely solve the customer demand and improve the customer's product competitiveness. Over the years, constantly refining PET bottle recycling system and single machine have enabled Boretech to pass ISO9000, ISO14000 and CE certification, to carry out long-term technical and cooperation with the international well-known manufacturers of automation equipment and to become an international leading manufacturer in the manufacturing of PET bottle recycling system. We will continue to the development of green technologies and leads the world toward a better future.

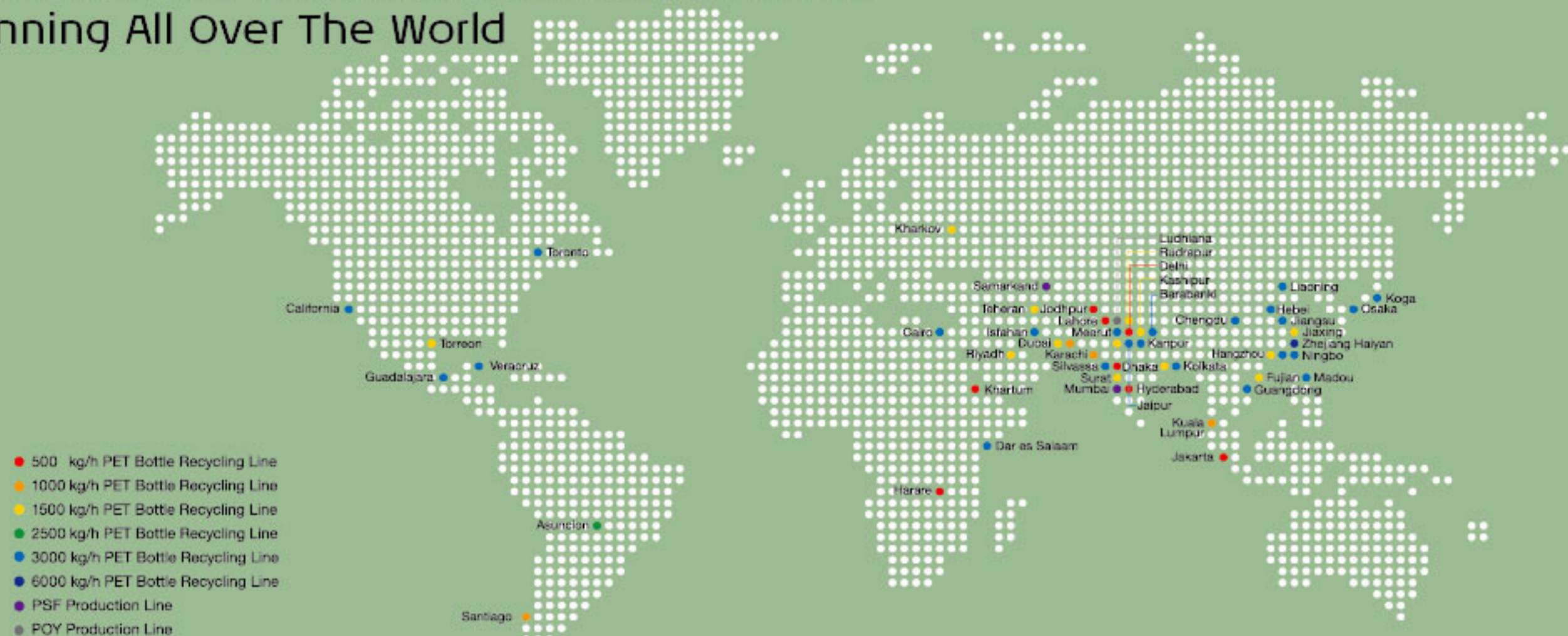
Product Lines and Equipment

- PET bottle recycling line with the standard input capacities of 500kg/h, 1500kg/h, 3000kg/h and 6000kg/h.
- All kinds of single machine for PET bottle recycling line.
- Production technology of PET granulation, SSP, sheet, PSF and POY of the whole plant and the equipment supply.

Service

- Investment feasibility analysis.
- PET recycling project planning and equipment selection.
- Whole plant design: Including the main process, subsystem engineering, utility system engineering.
- Process assurance and staff training.
- From basic design to turnkey project.

More than 100 Boretech Production Lines are Running All Over The World



Main Application of RPET Flakes

Good barrier properties of PET makes it become the main packaging material of all kinds of drinks, fruit juice, dairy products, tea drinks, mineral water and other food and beverage. At present, most of the PET bottles on the market in China are made from the native PET refined from the petroleum. PET bottles production up to 3,000,000 tons annually consumes more than 18,000,000 tons of petroleum,

and also causes tremendous pressure on the environment. Recycling and reuse of PET not only save the resources, but also can create wealth for society. According to the different quality levels, recycled PET can be reused to produce polyester staple fiber, filament, packing belt, sheets, food-grade chips etc.

- Polyster Staple Fiber**
- Filling (Quilt, Pillow, Mattress, Sofa Cushion, Plush Toy etc.)
 - Spinning (garment interlining, socks, shoe material)
 - Non-woven Fabric (Filter Material, Jushi Materials, Stereo Cloth, Yarn, Tennis, Sound-absorbing Materials)

- Filament**
- Dress Material
 - Blanket, Sheet, Towel



Packing Belt, Injection Products, Packaging Pallet, Film, Packing Box
Food-Grade Chips - Recycled Bottles



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Innovation of Recycling and Key Technology

The total global amount of PET bottles annually recovered is less than half of the total consumption; recycling technology is one of the key factors. How to make the recycling of PET bottles become more environmentally friendly, economical and convenient has been an important research topic in the field of PET recovery.

Removal of the PVC labels

PVC label of the heat shrinkable bottle has been a puzzled problem in PET recycling; the new continuous automatic label scrapping machine with patent developed by Boretech has solved this problem. Firstly, the label-removing machine is used to tear the labels on the surface of the bottle, then the label blowing device of our company is jointly used; by taking advantage of the differences of the density, the bottle and label are completely separated under the influence of the adjustable wind-force. Also, the label-removing spacing can be freely adjusted according to the size of the bottles, to change the angle of the bottle during the process those which can increase the label-removing rate and reduce the bottle breakage. Its high-efficiency label-removing performance will completely solve the problems of the industry.



Continuous Bottle Pre-washing and Water Circulation System

Continuous bottle Pre-washing machine with Boretech special design reduces the impurities mixed in the bottles to the lowest before the crushing. The equipment adopts a continuous feeding and washing, using steam and chemical water to clean the dirt and impurities on the bottle surface. To consider the input cost of the washing bottles, the whole line adopts the water circulation system and recycles the chemical water through the multi-layer filtering to reduce the amount of use of the detergent and water.



B-to-B Grade PET Bottle Recycling Line

Substantial consumption of the world's petroleum energy makes people pay more and more attention on the use of recycled PET. In recent years, Coca-Cola, Pepsi and some other well-known beverage manufacturers have begun the mixed use of regenerated PET material bottle blowing, which promotes the market demand of B-to-B grade PET bottle recycling production line.

B-to-B grade PET bottle washing line is mainly supported in the recycling project of food grade recycled PET chips; it has a high degree of automation and avoids the human error to the maximum extent. Efficient mixing and testing systems are to ensure that the PET flakes can meet the standard of the following processing. B-to-B grade bottle washing line of our company can flexibly adjust and configure the equipment and the process

according to the actual differences in raw materials input to meet customer needs in actual production. The whole line adopts the industrial control computer, with touch screen interact with PLC for control, which can intuitively and effectively control the various process parameters while collecting and recording the important process parameters on the whole line; we even combine the remote communication technologies to let our customers have no distance with us. It assists our users in production management practice, analysis and equipment maintenance. Meanwhile, the whole line is equipped with automatic material sorting machine and color sorter, which can greatly reduce the input of manpower and greatly improve the production efficiency, thus truly achieving the highly automated cleaning and recycling production line.

1 Flow Chart



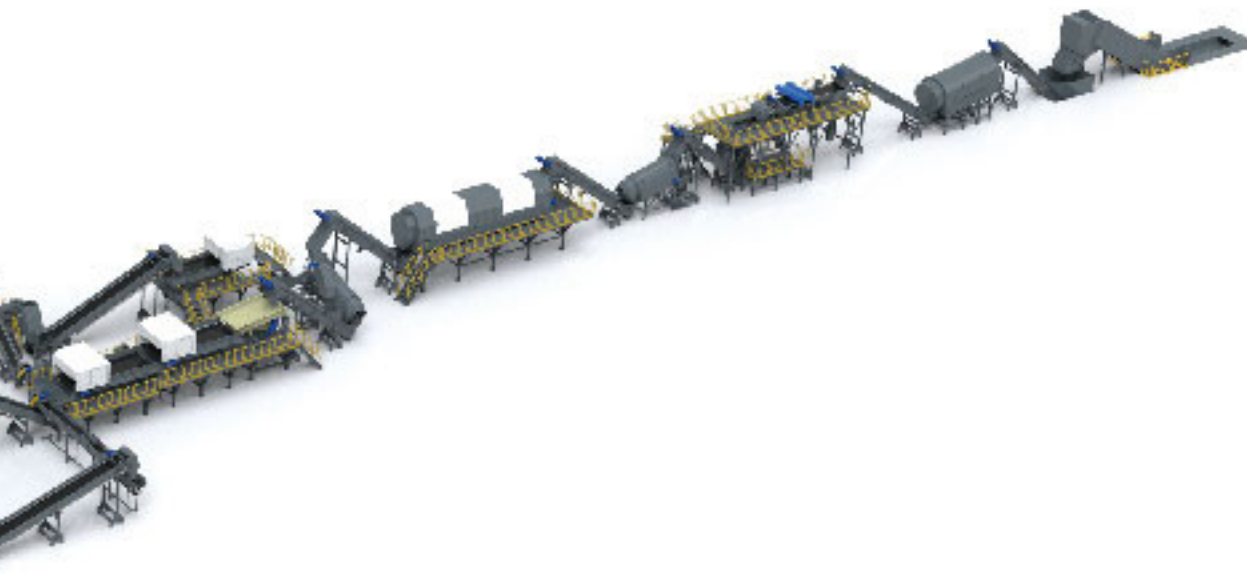
2 Flow Chart of B to B Grade Washing Line

De-baling > Dry Trommel > Metal Separation > Label Separation > Bottle Pre-washing > Automatic Bottle Sorting > Manual Sorting > Wet Grinding > Hot Flotation > Friction > Continuous Rinsing > Drying > Dust Removal > Metal Separation > Automatic Flakes Sorting > Packing

3 Estimated Plant Parameters

Capacity (kg/h)	Installation Power (kW)	Required Area (m ²)	Manpower	Steam Consumption (kg/h)	Compressed Air (m ³ /min)	Water Consumption (m ³ /hr)
500	300	600	4	280	1.5	0.75
1500	600	800	5	700	3.5	2.25
3000	900	1200	7	1300	6.5	4.5
6000	1000	2000	11	2300	12	9

* The above parameters are calculated based on the standard configuration; bottle bales type, quality and factory management level will affect the final actual consumption
 * Water consumption parameters are calculated based on using wastewater reuse system



4 Production Consumption Table

Average Consumption per ton Flakes

Capacity (kg/h)	Electricity (KWH)	Steam (kg)	Washing Detergent (kg)	Water (ton)
500	180	650	14	1.5
1500	170	550	12	1.5
3000	160	500	12	1.5
6000	150	450	12	1.5

5 PET Flakes Quality Reference Table

Moisture Content (%)	< 0.7
Label (ppm)	< 15
PVC (ppm)	< 10
Inorganics (ppm)	< 10
Glue (ppm)	< 10
PH (ppm)	7.5±0.5
PP/PE (ppm)	< 15
Metal (ppm)	< 10
Total Impurity (ppm)	< 100
Flake Size (mm)	≤ 12

Fiber Grade PET Bottle Recycling Line

Overview: In the era of highly developed polyester fiber technology, the recycled fiber production technology has gradually become a common technique. Competition in the industry has become the factory management and sales capability competition, especially the competition for raw materials. To use high-quality recycled PET, reduce the production losses, improve the product quality and improve the added value of products are the magic weapons for enterprises to win in competition. Recycling process of Boretech has solved this difficult problem for hundreds of fiber enterprises at home and abroad, which greatly prolongs the service life of the filter and components, and plays an important role in reducing the production loss and producing high-quality fiber.

PET flakes produced from the fiber level PET bottle washing line are mainly used in producing 2-D or 3-D polyester staple fiber, polyester filament, straps, sheet, film and other products. Our company has self-developed and manufactured PET bottle recycling equipment configured with TL series, T series, T-2000,

C-3000 and other dozens of production technology units. The best process route and configuration of each device unit can be planned and designed for various process equipment unit configurations in the complete sets of equipment in completely accordance with the users' raw material situation, production facilities, product quality and investment budget and other demands. Meanwhile, process monitoring, HMI, data analysis and other automatic control systems may also be adopted to ensure the equipment produces qualified PET flake which meet the requirements of the downstream market requirements. Among which, products with the input capacity of 1500kg/h and 3000kg/h in TL series of bottle washing line are the market mainstream products currently. Now, our company's washing lines have been sold to the United States, Mexico, Canada, Ukraine, Japan, Chile, Paraguay, Indonesia, Malaysia, Vietnam, India, the United Arab Emirates, Iran, Pakistan, Saudi Arabia, Tanzania, Sudan, Zimbabwe, Taiwan and many other countries and regions.

1 Flow Chart



De-baling > Matel Separation > Label Separation > Bottle Pre-washing > Manual Sorting > Wet Crushing > Hot Flotation > Friction > Contiuonus Rinsing > Drying > Dust Removal > Packing

2 Estimated Plant Parameters

Capacity (kg/h)	Installation Power (kW)	Required Area (m ²)	Manpower	Steam Consumption (kg/h)	Compressed Air (m ³ /min)	Water Consumption (m ³ /hr)
500	200	500	8	280	0.5	0.75
1500	400	700	12	700	0.5	2.25
3000	600	900	18	1300	0.7	4.5
6000	900	1200	30	2300	1	9

*The parameters above is based on the standard configuration, bottle bales condition and factory management will effect the water consumption.
 *Water consumption above is based on using water recycling system.

3 PET Flakes Quality Reference Table

No.	Description	AA level (ppm)	A level (ppm)
1	PVC content	≤ 30	≤ 100
2	PP/PE/colored flake/metal and other impurity content	≤ 70	≤ 100
3	Total impurity	≤ 100	≤ 200

*Factory management will affect the content of PVC.
 *Under normal circumstances, at least 80% of flakes will achieve the PVC content less 30 ppm of AA level.

4 Production Consumption

Average Consumption per ton Flakes

Capacity (kg/h)	Electricity (KWH)	Steam (kg)	Washing Detergent (kg)	Water (T)
500	140	600	10	1.5
1500	130	500	8	1.5
3000	120	450	8	1.5
6000	100	400	8	1.5

5 Flow Chart of Fiber Grade Washing Line

High-performance Dewatering Performance

Moisture content of the recycled PET will affect the price of flakes in downstream market, especially in the production of fiber. Boretech dewatering machine controls the moisture content of the end-products within 1%, which fully comply the market required.

Combination of Crushing and Washing

Crushing is an important operation unit in the recycling of PET bottles. Boretech grinder adopts the wet crushing method which achieves the cleaning effect through water added; on one hand, it can reduce the temperature heat due to generated friction and reduce the abrasion of the blades too; and moreover, it reduces the loss of the powder.



Future Outlook of Recycling Technology

After successive renewal and innovation of the PET bottle recycling in the past few years, the recycling process and technology become more mature, more automation, and more cleaner production, those of which from an inevitable trend in the growth of PET recycling industry. While the regenerated fiber market gradually goes into the saturated state, B-to-B grade recycling system draw more and more attention and popularity in the industry. Over the

Intelligent Operation Control Interface

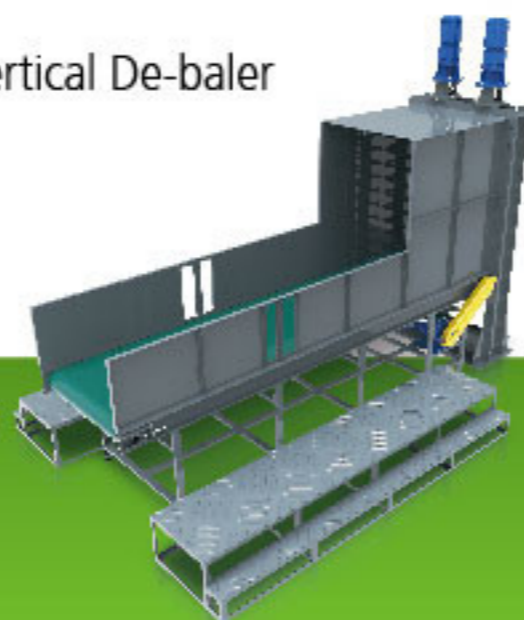
The whole line can adopts the DCS or PLC control system; the real time information acquired by this system can make the PET bottle recycling system into the automatic management program. In addition, the system can acquire the equipment running information and repair errors immediately, and then generates a production information statistics report and predicts a repair time. An effective monitoring system can reduce production costs, prevent mechanical from failures and improve production stability and plant safe production.

De-baling

A mechanical structure is used to break up the PET balers with merits of high automation technology, simple operation process, low power consumption and equipment abrasion those which solve the bottleneck problem of the industry. Boretech equipment has the incomparable advantages than other high power consumption equipment in saving energy and manpower.



Vertical De-baler



Horizontal De-baler



PVC Label Separation

Labels of PET bottles with heat shrinkable labels cannot be removed through bottle Pre-washing, which is a trouble affecting the PET recycling. Boretech high-efficiency label scrapping machine with patents can completely solve this problem. Its concept is to tear the labels on the surface of the bottles, so that the labels will not adhere to the bottles body; then the blowing device should be used according to the differences of the density and the area of the bottles and labels, the bottles and labels are completely separated under the influence of the adjustable wind-force.



Label Blower



Label Scrapping Machine

DE-BALING

LABEL SEPARATION

Metal Separation

Metal impurities mixed in the recycled PET bottles will affect the next application and production of PET; in this regard, Boretech adopts the metal detector which uses the digital technology with the belt conveying device or automatic flapping device to separate the ferrous and non-ferrous metals in the raw materials. Using automatic flapping device makes the whole production process uninterrupted, thus realizing the automation and reducing the number of labor.

Besides, belt type metal separator can also remove ferrous metal automatically.



| Metal Detector

| Automatic Metal Flapping Device



Bottle Pre-washing

As much as possible to remove the external impurities before crushing is an important basis for ensuring the quality of final PET flakes and reducing the production costs. The biggest feature of this process is the automated water circulation system, continuous feeding and washing. This system uses the structure specially designed to cause friction of PET bottles inside the machine, and uses the high-temperature chemical water to remove the labels, dirt, sands, glues, rubbers, metal and other impurities on the bottles surfaces.

Chemical water temperature and supplement automatically controlled can ensure the bottle washing quality. The supporting chemical water filtration system separates the impurities in the water by using the coarse filter, fine filter, sedimentation and other methods, to prolong the service life of the chemical water and save the washing costs.

Whether the recycling process is supported with the automatic sorting system, the bottle Pre-washing unit has a significant impact on the PVC contents in the recycled flakes. High-temperature washing can make changes in the appearance of PVC bottles, making it easy to distinguish in the PET bottles and manual sorting become very simple; meanwhile, the bottles cleaned can allow the automatic selection system with higher sorting efficiency.

Intermittent washing for the recycling of oil bottles can be adopted to ensure that there is sufficient contact time for the bottles and the chemical water, so that the oil can thoroughly dissolved, finally achieving the cleaning effect.

| Batch Pre-washer



| Bottle Pre-washer



Crushing

Water can be added in the grinder with special structural design in the process of crushing to allow the flakes to carry out the first friction cleaning while reducing the temperature in the crushing room and abrasion of the blades; the most important is to reduce the output loss of the powder.

With more than 20 years of experience in the recycling of PET and manufacturing of grinders, we advance in the direction of low failure rate through mechanical structure design, material selection and manufacturing process technology.



Hot Flotation, Glue-removing

In order that the impurities in the final products can be reduced to 100ppm even to 50ppm, secondary washing of the flakes after crushing is very important. This unit is composed of automatic water filtration system supported with hot washing, turbo friction washing and automatic detergent dosing system. Close connection and reasonable collocation of the functions can effectively remove oil, glue and other impurities attached to flakes and meanwhile separate bottle caps and rings. All of the above is the automation control to reduce the production costs and realize the high efficiency of the production process.



| Crusher



| Turbo Washer

| Dryer



| Vibrating Screen

| Hot Flotation Machine

CRUSHING

HOT FLOTATION AND GLUE-REMOVING

Continuous Rinsing, Drying

The central idea of the process lies in the further separation of impurities. Clean water is added to finally and thoroughly clean the bottle flakes to remove the detergent left on the bottle surfaces during the previous heat floating washing and some separated suspension after the friction to ensure the cleanliness and transparency of the PET flakes, then the high-speed machinery is used for the centrifugal dewatering so that the moisture rate of the flakes will be reduced to 1~2%. If the heat exchange drying is supplemented later, the moisture rate of the flakes will be further reduced. For the downstream polyester staple fiber or POY filament application, using the high-speed mechanical dewatering equipment of our company is enough to meet the market demands.



Blending, Dust Removal and Packing

Flake with low impurity content and stable quality is a standard to measure the PET recycling process. For the various quality factors during the process of PET recycling, blending equipment and on-line detection device especially designed can ensure the various quality indexes to meet criteria and to make sure no single index exceeding the standard, so that the quality of the flakes will be guaranteed.

Combined with the years of experience in the production of PET industry, PET dust has an important impact on the next production, especially the production process of POY and PET sheet.

Dust-removal equipment can effectively separate the free dust in the flakes, small plastic labels or film by taking advantage of the gravity and the internal structure specially designed.

Packing unit, by taking advantage of the vibration system specially designed, can make the packaging of the flakes reach the fix weight and maximize packing density, which greatly reducing the packaging and transportation costs.

Dryer

Second Rinsing Machine

First Rinsing Machine

Blending Silo

Zig-zag Separator

Packing Silo

CONTINUOUS RINSING AND DRYING

BLENDING, DUST REMOVAL, PACKING

Integration of Optical Sorting Equipment

This unit can adopt the world-renowned sorting manufacturers for the cohesion and integration with the PET washing line of our company. In the region with relatively expensive human labor, automatic sorting machine plays a very important role; it not only can reduce the management cost and reduce the amount of demand of personnel, but also the sorting quality can be guaranteed. Color sorter sorts different colored PET bottles or bottle flakes through the optical sensor. Material

sorting machine can identify and separate the bottles or bottle flakes with non-PET material through the near-infrared detectors; in the process design, two to three automatic sorting machines will be set, one to two for selecting the color and one for selecting the material. Of course, more equipment can be set to ensure the selecting quality and reduce the loss by taking advantage of different processes.

Bottle Sorting Machine



Flake Sorting Machine



OPTICAL SORTING EQUIPMENT

Reference Project

As of mid-2014, there have been more than **100** Boretech PET bottle recycling lines in operation around the world. There are more than **700,000** tons of recycled PET flakes produced from Boretech equipment around the world annually.

