



Herbold PET Bottle Washing Lines – State of the Art Systems

Herbold PET Bottle Washing plants Producing flakes of Highest Quality

Postfach 1218
D-74908 Meckesheim
Tel.: +49 / 6226 / 932-0
Fax: +49 / 6226 / 9 32-4 95
E-mail: Herbold@Herbold.com
Internet: www.Herbold.com

Introduction

Herbold Meckesheim GmbH, in the South West of Germany is a family-owned business specialized in the engineering, manufacturing and supplying of size reduction and recycling equipment for the plastic processing industry as well as for the plastic recycling industry.

The company is owned by Werner and Karlheinz Herbold, two brothers, who are also the Managing Directors of the company. They continue a more than one-hundred-year-old family tradition in designing and manufacturing size-reduction machinery that was started in 1884 by Adam Herbold.

We are approx. 90 employees and in 2008 had a turnover of about 24 million Euros. We supply our plants and systems world wide, in more than 70 countries all over the world.

One of our main fields of activities is the engineering of turn key washing lines and components for all types of contaminated plastic waste, e.g. post- consumer film, agricultural film, HDPE bottles, washing plants for car battery cases and, of course, for post-consumer PET bottles.

I am very pleased to have the opportunity today to present the possibilities of my company in supplying turn key plants as well as components for the production of PET bottle flakes which meet the highest standards in the market.

The Basic Herbold Philosophy on Washing Plants

Our PET bottle washing system has been designed in a certain order to obtain an increasing quality of the flakes after each processing step and to minimize energy and fresh water input required for the final product. The complete system has been built on a gradient scale where each process stage achieves a distinct result in the cleaning process which allows the next process stages to forward the whole cleaning operation to the expected and defined final flake specification, always using a minimum of energy, chemical agents, and fresh water.

Another important point is the sturdiness and reliability of our single components of our washing lines. To withstand the rough conditions due to the often heavily contaminated infeed stock, our machines are sturdy, solid and of intelligent simplicity. The critical machine parts have been designed with replaceable wear parts which can be easily exchanged and reduce down time periods to a minimum. This guarantees long years of reliable operation which is exactly what you can expect of a world leading supplier of washing lines.

Herbold stays always in close dialogue and service support with our customers which helps to continuously improve our systems and allows us to present always the best solution to our customers. It is understood that this can only be managed if one has an excellent engineering division and does not know and understand the process but also the function of each component. This usually leads to innovations of which Herbold has been developing major ones even in the last 3 years 4 and which we will present in detail in this lecture.

Process Stage 1

Debaling, Basic Cleaning and Separation Steps

A) Debaling of bottle bales

This is the first important step which needs to work without problems. It breaks the bales into single bottles to allow the further treatment of the bottles. We supply very robust and sturdy units as the bales are often heavily contaminated with foreign bodies and are just dumped onto the conveyor belt. It is a rough operation,

therefore we are prepared for a heavy duty application. All key parts have been designed as exchangeable wear parts.

B) Pre-washing and removal of labels

It makes no sense wasting heating energy at this step as some of our competitors do. At this entering stage you have bottles with all types of contamination of which you need to get rid of with a minimum numbers of units and with a minimum of costs due to energy and consumables like water or chemicals. The surface dirt of the bottles and the labels is scratched and washed off by the feeding/washing screw and the label remover. **The label remover is one of the novelties** Herbold has developed in the recent months. This step after debaling takes care of the superficial dirt on the bottles and it particularly removes labels to a large extent which are extremely disturbing to the process if these are for example out of PVC. After this step the bottles are conveyed to the sorting step, pretty clean, and we have invested only a minimum of energy and are using the recycled cold water only. By this pre-washing step the bottles are prepared for the next level of treatment.

C) Separation, sorting and metal extraction

The superficial cleaned bottles nearly free from labels can now be ideally processed in a NIR system. The quality of separation will be much better with these pre-treated bottles.

If no NIR system is used, it is recommended to install a full size manual sorting cabin. We propose a cabin as it protects the workers from noise, it is easily vented, illuminated and in the winter months, it can be heated. It is, however, no problem to supply an open sorting station with conveyor belt and platform instead a cabin.

Either before or after the NIR system metals are taken out of the bottle stream using overhead magnets, magnet rolls, eddy current separators or metal detectors in combination with electro-pneumatic discharge flaps.

Process Stage 2

Basic Washing, Size-reduction and Air Separation Steps

A) Basic washing and size reduction

Herbold has invented the use of granulators for the size reduction with water. The friction in the cutting chamber of the granulator can ideally be used for the washing of the PET bottle flakes by adding continuously water into the cutting chamber. The result is always convincing. In order to keep the consumptions of fresh water low, the water which is being used is mechanically treated water in a closed loop, the same water which we use in the first stage. The wet grinding process removes dirt from the PET bottle flakes, removes sugar and washes off all kind of contamination. It also increases the lifetime of the blades considerably, compared to dry grinding. The dirty water and the washed flakes are discharged through the screen of the granulator into the next unit. Only good things are copied, and most of our competitors, now follow our wet grinding concept.

Herbold, however, has now advanced the use of granulators as part of the wet or even dry size reduction step with the innovation of the Herbold granulators of the SB series. It is a granulator which has 2 or 3 feeding screws – depending on the width of the granulator – forcing the material into the cutting chamber. This new series of granulators has several advantages over the standard types of granulators: Higher capacities up to 150% more with the same machine size and same motor size compared to a standard granulator. The controlled feeding of the bottles into the cutting chamber means an even electrical load and without high peaks as you will find them on granulators with standard design. **This saves a great amount of energy and therefore will reduce costs in a short period of time.** (We have applied for a patent for this new granulator series. It is available in five sizes with capacities up to 7 tons/h.)

B) Separation of dirty water, further cleaning and drying

The waste water and the flakes enter a friction washer through the screen of the wet grinder. The job of the friction washer consists of separating the dirty water from the flakes and continuing the washing of the flakes. The flakes are discharged into a mechanical drier. The mechanical drier uses its centrifugal force to spin off the superficial water from the flakes and dries the flakes for the air elutriation separation process.

C) Air separation of dirt, dust, remains of labels

At this stage, the flakes still contain remains of labels, dust as well as loose dirt which have been washed off from the bottle flakes but could not be spun off through the screen holes of the friction washer or the mechanical drier. In the Herbold air separator (elutriator) the loose dirt, labels, paper remains etc. are now separated from the PET flakes by an adjustable air flow. As said earlier, it is our philosophy to take away as much dirt and contamination as possible in each step and with the simplest possible means. The flakes are now very clean and in an ideal condition to undergo a basic separation of PET/PE, PP.

Process stage 3

Basic separation of PET from PE/PP

Herbold has 2 process steps to separate the PE/PP from the PET flakes and as an additional benefit to clean the flakes further from impurities. Herbold's first separation process is the swim sink tank and the second is the hydro cyclone separation process which follows the hot wash process. After the wet size reduction step the flakes are pretty clean but the material stream still contains PE/PP from the bottle caps or some PO bottle flakes. These are separated in the swim sink tank from the PET flakes. To achieve an optimum separation result the flakes are force-fed into the tank under water level. The polyolefines surge up and swim whereas the PET flakes easily sink to the bottom of the tank where they are continuously discharged. The mechanical drier following the swim sink tank ensures that the flakes are dry, thus only dry PET flakes will enter the hot wash step.

Process stage 4

Hot wash step

A) Production of pure and clean flakes

We are entering the hot wash step with dry and more or less pure PET flakes. Dry flakes: to avoid cold water being mixed into the hot wash water which would reduce its temperature and require an additional input of heating energy. More or less clean flakes to allow this hot wash step to do its proper cleaning function. We are more efficient in cleaning the flakes if we leave each stage to do its distinct function and do not mix it to fulfil various jobs. The Herbold Hot Wash Process is designed to release the glue from the flakes and to release remaining impurities like sugar etc. under strict control of the various process parameters like pH level, chemical percentage, residence time and temperature. We have three steps in which the flakes undergo the hot wash process to achieve flakes as clean as necessary to produce with further processing steps new bottles out of it. The first is a reactor tank which prepares the flakes and discharges the flakes in a controlled way into the following 2 hot wash agitating tanks. The residence time of the flakes in these 3 steps can be adjusted to achieve the best results. The whole process is automatically controlled, caustic soda and detergents added as required.

B) Low cost operation of the Herbold hot wash stage

The operation of the hot wash process can be very expensive. Herbold has therefore taken measures to keep the costs for this step as low as possible. The first measure is the introduction of the Ultra Filtration System into the hot water process flow. This ensures a closed water process loop. The ultra filtration system filters the released glue and other impurities out of the hot wash process water while the caustic soda and washing agents are not separated. The loss of heat in the process water is kept to a minimum. **The Ultra filtration process is another Herbold novelty of the last years.** The second measure is the heating of the process water during operation with steam. Heating with steam costs only half compared to heating with electricity if your costs for electricity are as high as they are in Europe. Low operational costs are a key to your success!

Process Stage 5

Advanced High Quality Separation and Rinsing Steps

We have here an additional step for the separation of PE/PP caps and labels, glass, metals like aluminium and other impurities. Bear in mind that at this stage, the PET flakes are already very clean and the impurities listed above are only present in very small percentages – already in the ppm range - and we are now concentrating our efforts to bring the flakes into the final quality. This is of course easy if the bottles and flakes have passed each previous process stage as described above. This additional step is the Hydro Cyclone separation step which is much more efficient than any swim sink process as it works with approx. 18 g (earth gravity) compared to 1 g in a swim sink tank. While the first hydro cyclone - the heavy medium cyclone - separates the remaining particles like glass, aluminium, particles heavier than PET, the second hydro cyclone gets rid of the contaminations (like PE/PP) lighter than the PET flakes. It is a process working miraculously and unique in the world of PET bottle washing lines. Beside the separation and additional cleaning, this process rinses the flakes and ensures that any chemical remains from the previous process are completely washed off. The friction washer at the end of this step guarantees a closed water loop by dewatering the flakes and sending the water back to the process via a screening unit.

Final Process Stage 6

Drying, Air Separation and Bagging.

The PET flakes are discharged out of the friction washer into a mechanical drier to produce dry flakes ready for the "polishing" procedure. The dry flakes could still be "contaminated" by traces of impurities like label remains, metal traces or dust and one likes having the flakes free of these remains. These remains are only present in traces at this point and you would hardly be able to recognize them if you looked at the PET flakes. But Herbold has added this step to ensure that we do not only have an excellent product but also a product fulfilling the highest quality demands. The air separator (elutriator) is a type of zig zag channel where any loose dust or impurity is taken out by a frequency controlled air stream at the top and where the PET flakes leave the unit at the bottom. Any possible metal remains are separated in a metal separator at the exit of the elutriator.

The PET flakes are now ready for bagging or to be conveyed into a storage silo.

Process water treatment

An important point that is often forgotten in considering a washing line: The water circuit. The system to recover the washing water in the line plays an important role in the running costs of a washing line. Nobody can afford a washing system that uses only fresh water for the process, there will always be a high percentage of washing water running in loops which needs to be at a reasonable quality for a good washing result.

In order to minimize the need for fresh water Herbold runs 2 separate water loops: the hot wash water loop and the cold wash water loop. The general flow of water is obviously from the overflow of the hot wash process into the cold wash water circuit but not in the other direction.

A) Hot wash water circuit

As mentioned in the chapter about the hot wash process stage, Herbold has included the Ultra Filtration System into the treatment of the hot wash to ensure a closed water loop, clean process water and low operational costs.

B) Cold wash water circuit

The main washing is done with cold, mechanically treated water. It is of course necessary to keep the adding of fresh water to a minimum. Therefore, the mechanical treatment has to remove most of the coarse contamination in the water. This is done with screening, sedimentation, centrifugal treatment or flocculation depending on customer's own possibilities.

C) Evaporation of dirty water

In some areas in the world any adding of fresh water is extremely expensive and demands for a system with a water loss close to zero. Herbold has developed **an evaporation system of the dirty water** with which the adding of fresh water per hour is nearly zero. **Another novelty from Herbold to keep the operating costs down at the lowest possible level.**

Electrical control of the system

The electrical control of the system can either be a standard control panel, easy to maintain by any qualified electrician or a full state of the art PLC. This is the customer's choice and depends on his available resources in manpower.

Summary

Herbold washing lines are being built with more than 25 years of experience. Our systems are of a modular design which will allow customers to start with basic process steps or to add these steps or components to existing lines.

Our PET bottle washing system is built on a gradient scale where each process stage achieves a distinct result in the cleaning process which allows the next process stages to forward the whole cleaning operation to the expected and defined final flake specification, always using a minimum of energy, chemical agents, and fresh water.

Another important point is the sturdiness and reliability of our single components of our washing lines. The critical machine parts have been designed with replaceable wear parts which can easily be exchanged and

reduce down time periods to a minimum. This guarantees long years of reliable operation which is exactly what you can expect of a world leading supplier of washing lines.

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Siegfried Engel

1st August 2009
Vice President

Herbold Meckesheim GmbH