A Guide to Sanitary Product Recovery (Pigging) for

Chocolate and Confectionery Manufacturers

HPS Product Recovery Solutions

Quality • Innovation • Simplicity • Integrity

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Summary

For companies that process liquids, product recovery ("pigging") is one of the most effective ways to improve product yields. It also reduces waste, speeds up production, helps sustainability and has a positive impact on the environment. Other benefits include reducing cross-contamination risks and using less of the products used to flush pipelines.

Sanitary product recovery and pigging systems are particularly effective, and in wide use, in chocolate and confectionery production. That's because pigging delivers significant gains.

There are some special considerations with confectionery, and chocolate-based products in particular. For example, because the transfer lines are often jacketed (heated to keep the chocolate fluid), the pigging equipment must also be jacketed and able to retain and sustain the heat without degradation. In addition, for chocolate-based confectionery, products such as butter, oil or both are used for flushing. This is instead of water, which is often used when flushing other foodstuffs.

Pigging reduces the use of these flushing products significantly, so saving money, saving time and reducing waste even further.

This guide provides an overview of sanitary (often called hygienic) pigging for chocolate and confectionery manufacturers. It includes an introduction to how pigging works, the benefits of pigging, types of pigging system and types of pig, and how to plan a pigging project. It also has sources of further information.

"The pigging solution was simple to use. The HMI was customisable to suit our needs and everyone we dealt with from sales to parts to installation and programming was fantastic to work with"

- Jeff Green, Log House Foods

Why Chocolate and Confectionery Manufacturers are Pigging?

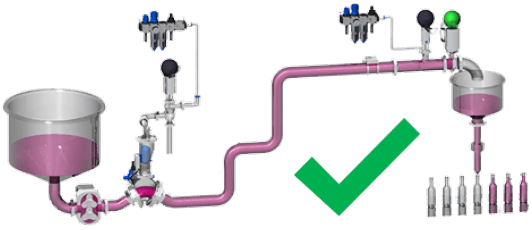
Here are some of the main challenges facing chocolate and confectionery manufacturers and why an increasing number of them are implementing pigging systems into their manufacturing plants and production facilities.

With raw material costs rising, chocolate manufacturers want to ensure they use everything they buy and avoid throwing high-priced inputs down the drain.

The increasing demand for products that are greener and sustainably produced.

Increasing competition. Manufacturers that aren't agile and efficient risk being left behind.

Many manufacturers have sustainability targets they need to meet, for example waste reduction, energy usage targets.



Customers are becoming more discerning and demanding, which is putting pressure on chocolate and confectionery manufacturers to innovate and introduce new products. As such, they need a solution that can handle multiple products.

The threat of cross-contamination. When an incident occurs, it can attract media attention that has a negative impact on a brand. Therefore, manufacturers are implementing technologies to minimise the risk.

Key Statistics and Takeaways:

- ✓ The highest quality pigging systems typically recover up to **99.5%** of useable, residual liquid from pipes. This recovered liquid can continue to be processed, packaged and sold.
- ✓ Payback from Pigging Systems is typically **less than 12 months**, delivering a **high ROI.**
- ✓ There are different types of pigging system, from simple source-to-destination solutions to multiple-source and multiple-destination projects.
- ✓ Nearly all pigging systems are bespoke, and most are either semi or fully automatic.
- ✓ Pigging is effective – each changeover, a butter oil manufacturer **recovers approximately 200 kgs of good product** that would otherwise be wasted or become effluent.
- ✓ Instead of running product to drain before changeovers, a leading chocolate manufacturer in Bulgaria deployed an HPS Pigging System. Residual product is now packaged and sold rather than wasted, the company has minimalized contamination risk and changeovers now take only a few minutes.
- ✓ A large chocolate manufacturer in California uses a combination of semi-automated and fully automated pigging systems in a range of sizes. These systems massively increase efficiency, reduce the risk of human error, speed up processing and changeovers, and minimize waste.
- ✓ Pigging also saves on products used to flush the lines, such as butter, oil or if used, water.
- ✓ Pigging assists production and quality control. A confectionery manufacturer **improves lot control** and **prevents products from sitting unavailable for extended periods of time**.
- ✓ By reducing wastage and improving efficiency, pigging is a great help towards **environmental sustainability**.

What Is Pigging?

If you drink wine, beer, spirits, fruit juices, cola or other types of soft drinks; if you eat chocolate, candy, sweets, yogurt, soup, honey; or if you use paint, varnish, shampoo, cosmetics, toothpaste, washing up liquid or other household product, then you have probably drunk, eaten or used something that's been 'pigged' during its production.

In the chocolate and confectionery industry, sanitary pigging recovers residual liquid or wet product from pipes. If it wasn't recovered by pigging, it would go to waste. This recovered product is perfectly useable so can be sold or continue to be processed along with the rest of the batch, rather than being disposed of.

How Pigging Works

In its simplest form, a pigging system consists of a solid projectile (the 'pig') with a diameter slightly larger than the pipeline transporting the liquid. The pigging process introduces this pig into the pipeline (usually automatically) and pushes it through the pipe.

To 'pig' a system, pigs are propelled through the pipe by pressurizing the pipework behind it. Compressed air, carbon dioxide, nitrogen, the next product or specialist propellants (depending on the application) provide the pressure.

Instead of being sent to drain, waste treatment or collection areas, the liquid residue in the pipe is recovered: pushed by the pig and forced to the destination filler or tank, or returned to source, to continue processing along with the rest of the product.

HPS pigs, which are the benchmark of the industry, recover up to 99.5% of product. As well as increasing yields, pigging at this level also reduces the need for flush and clean-in-place, saving time, labor, cleaning products and other fluids, and subsequent waste disposal costs.

Benefits of Pigging

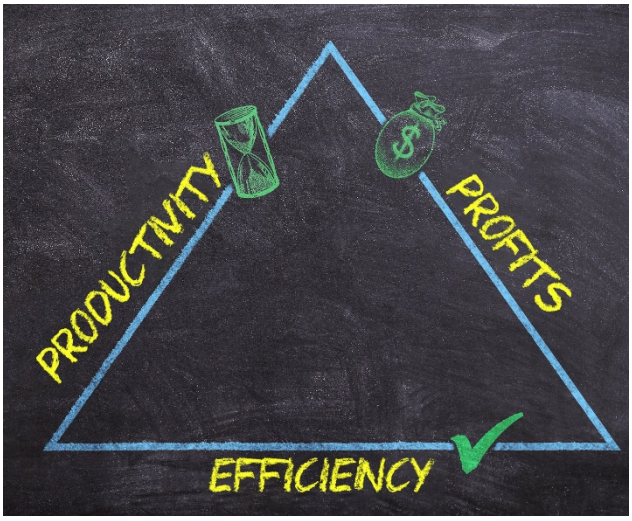
Sanitary Pigging and Product Recovery Systems deliver a wide range of benefits and a high return on investment. The benefits include:

- ✓ **Increased Profits, Productivity and Efficiency**
- ✓ **Higher Product Yields**
- ✓ **Higher Capacity and Increased Flexibility**
- ✓ **Lower Labor Costs**
- ✓ **Less Downtime**
- ✓ **Reduced Waste Processing**
- ✓ **Lower Cleaning Costs**
- ✓ **Faster Changeovers**
- ✓ **Reduced Chemical Usage**
- ✓ **Improved Production Quality and Lot Control**
- ✓ **Minimized Cross-Contamination Risks**
- ✓ **Improved Environmental Sustainability**
- ✓ **Smaller Carbon Footprint**

Increased Productivity and Efficiency

Because pigging systems recover significant amounts of useable product from processes, there's more product to sell. Alternatively, less is required to achieve the same output.

In addition to increased profits, pigging systems streamline processing; reducing effort required and making various operations a lot quicker. They can even eliminate some process stages altogether, for example dismantling pipework or flush outs.



Typically, a correctly designed and implemented pigging solution will pay back the initial cost of the system within one year. Good quality pigging systems last a long time (some HPS systems are still in use after 20 years), so return on investment is significant.

For example, a large chocolate manufacturer in California uses a combination of semi-automated and fully automated pigging systems in a range of sizes. These systems massively increase efficiency, reduce the risk of human error, speed up processing and changeovers, and minimize waste.

Higher Product Yields

Increased product yield is one of the most common reasons organizations use a pigging system.

Whenever a process transfers liquid along a pipe, there's nearly always product residue left in the pipe. Even gravity fed lines don't evacuate all the product. The more viscous the product, the more residue there is. Pigging systems will help you recover nearly all this residue, as useable product.

As an example, instead of running product to drain before changeovers, a leading chocolate manufacturer in Bulgaria deployed an HPS Pigging System. Residual product is now packaged and sold rather than wasted.

Similarly, a butter oil manufacturer recovers approximately **200 kgs of good product that would otherwise be wasted** or become effluent.

Higher Capacity and Increased Flexibility

Manufacturers of chocolate and confectionery may pump many different formulations and configurations of product. However, it's inefficient to have a dedicated line or lines for each product.

Because HPS pigging systems recover nearly all residual product from the pipeline(s), this enables the same lines to be used for more than one product and reduces the number of dedicated lines there are. So, the many dedicated lines can be replaced with a lower number of shared lines. This increases the capacity and flexibility of operations. It also reduces the costs of new installations.

Faster Changeovers

When companies expand product ranges, it's often desirable to use previously dedicated pipelines. However, changeover from one batch to another can account for significant product loss, high wastage costs and less productive human-resource hours.

Pigging speeds up product changeovers because it reduces the length of the wash. If there is only a slight change in product color or flavor it is often possible to follow on immediately with the next product after pigging, eliminating the need for flushing altogether.

Reduced Butter, Oil and Flushing Product Usage

With chocolate-based confectionery, it's common to use butter, oil or both to remove residual product from within pipes. This is a time consuming, multistage process. For example, there could be an oil wash to remove residual chocolate out of the line, followed by a butter flush to remove the oil. While sometimes the oil may be reusable, the butter is not.

Pigging can eliminate the butter flush altogether, while removing nearly all product to significantly speeding up the oil flush. This delivers large savings on butter and oil. It reduces material handling and speeds up the whole process, saving time, labor and money.

Reduced Water Usage

Although chocolate production doesn't often use water for rinse or flush, water is used with some other types of confectionery and food processing. In this case, the first part of a clean-in-place cycle is to flush out the product residue with water for a period of time before actually proceeding with the cleaning process. If most of the product has already been removed by pigging, then there's no requirement for a lengthy flush out. This reduces water usage significantly.

Reduced Waste Processing

By increasing product yields through pigging, there's less product to send to waste. What's more, the cleaning and changeover processes also use less cleaning fluids. In this way, sanitary product recovery and pigging systems directly reduce waste processing costs.

Lower Cleaning and Labor Costs

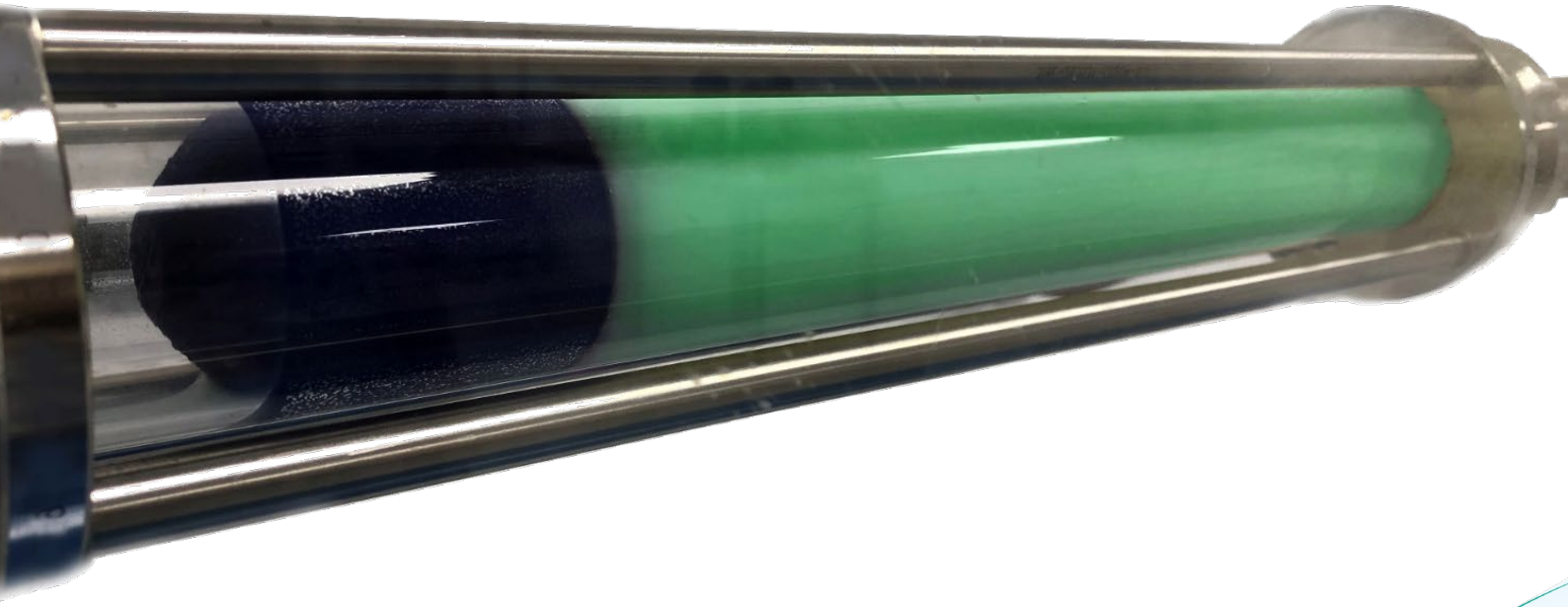
Pigging reduces the effort and resources needed to clean pipelines. Because there's less product to remove, cleaning is quicker and requires less labor. Pigging also speeds up changeover times so there's less downtime. Semi-automated and fully-automated pigging systems reduce labor costs even further.

Improved Production Quality and Lot Control

Some products should not be left stationary within a pipeline, either because they may deteriorate or because they may solidify. Using pigging, a well-known manufacturer of chocolate coatings pushes significant amounts of product to storage rather than leaving it in the pipelines. This improves lot control and prevents products from sitting unavailable for extended periods of time. It also helps prevent settling and freeze-ups because operators can clear the pipe as frequently as they like with little to no effort.

Reduced Product Contamination Risks

Because HPS pigging systems have high product recovery rates, the chances of product contamination and cross-contamination are greatly reduced. This in turn means more consistent product output, lower rework and better control over raw material and finished product inventory are among the many benefits of pigging systems.



Positive Environmental Impact

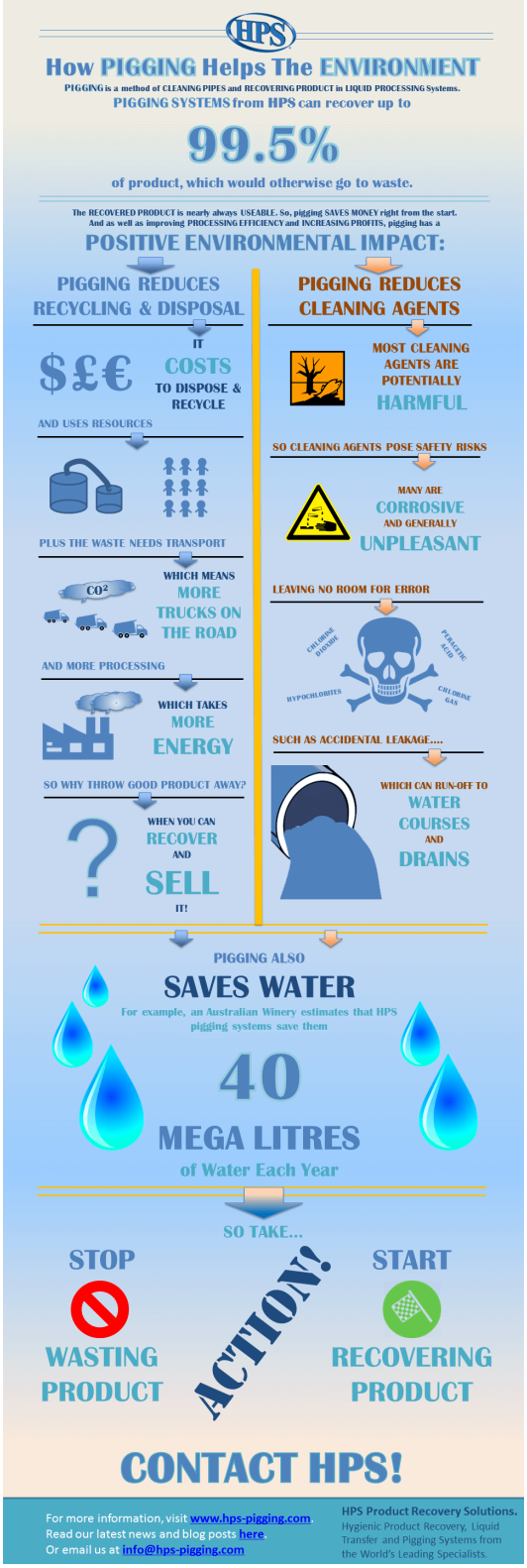
Many chocolate and confectionery manufacturers have strong environmental sustainability initiatives. Therefore, the positive environmental impact of pigging is a key benefit to many chocolate and confectionery producers and processors.

As well as forming part of an ethical business strategy, being environmentally responsible is increasingly important to consumers, employees, and other company stakeholders.

The costs of removal or treatment of waste has become a major expense to many companies. Additionally, changes in legislation and environmental policies can lead to manufacturers deploying extra resources and incurring further costs.

An effective way of reducing these costs, while reducing carbon footprint and improving sustainability, is to pig the product transfer pipelines. This significantly reduces waste and associated costs.

Pigging saves product and saves energy. It reduces the use of harmful chemicals and associated disposal requirements. It also means fewer trucks on the road. In practical terms, the positive environmental benefits of pigging are considerable.



How Pigging Helps the Environment

“The receiving line holds between 500 and 2500 lbs of coating depending on which storage tank we are using. With minimal waste (less than 25 lbs typically), we can push all that material to storage rather than leaving it in the pipes. This improves lot control and prevents products from sitting unavailable for extended periods of time”

- Jeff Green, Log House Foods

Types of Pigging System

Pigging systems can be deployed in existing plant, as well as part of new projects or installations.

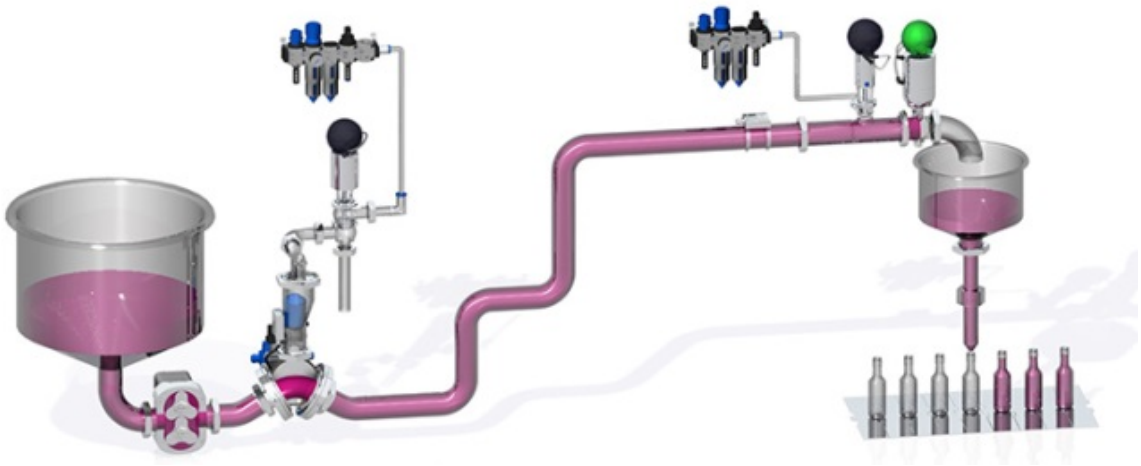
Because every company's processes and systems are different, every pigging system implementation is bespoke; there's no such thing as an effective 'off-the-shelf' sanitary pigging system. However, in chocolate and confectionery processing, pigging systems tend to fall in to one of three categories:

- ✓ Single-Pig Systems
- ✓ Double-Pig Systems
- ✓ Tank Drop-Off Systems

While these systems can be controlled manually or semi-automatically, most are controlled fully automatically. In particular, double-pig and tank drop-off systems are nearly always fully automatic.

Single-Pig System

Single-pig systems are the most common type of pipeline product recovery solution. They are also the simplest; generally sending one pig from one source to one destination when the main product transfer process has paused or finished.



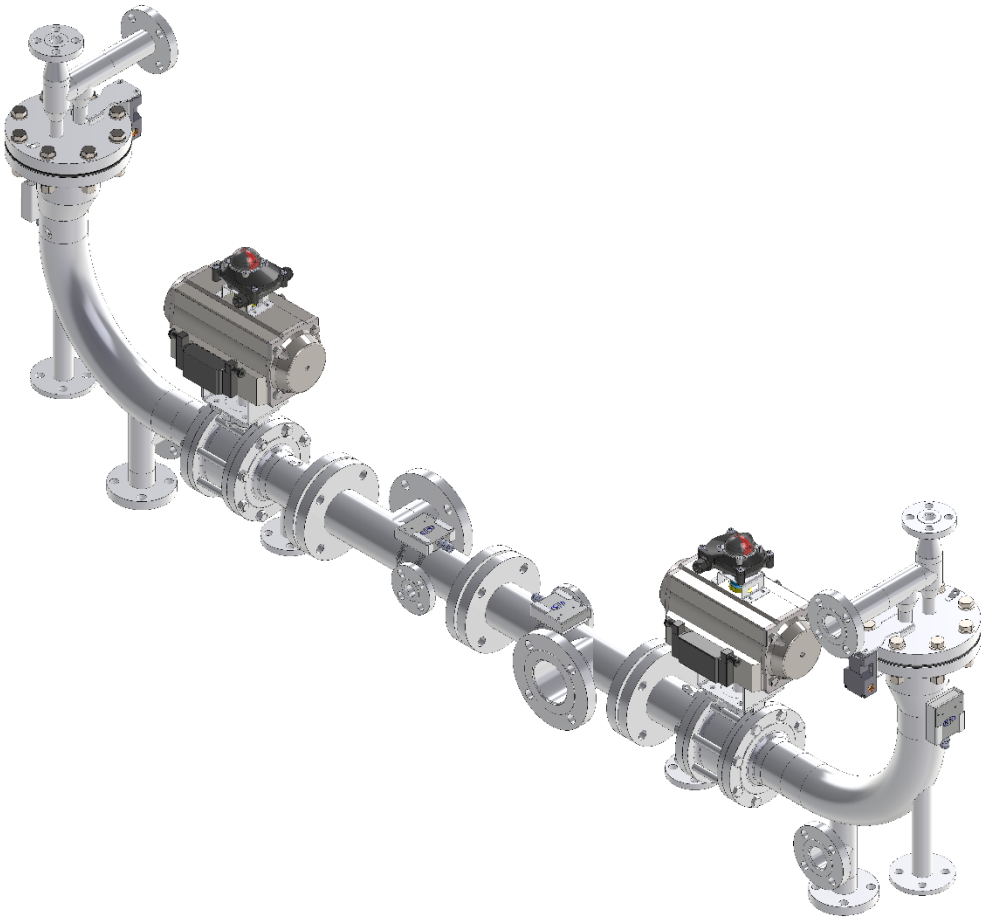
Single-pig System

In a single-pig system, the pig can either send recovered product to the destination (for example a tank) or back to the source tank.

Double-Pig System

The double-pig system is typically used for processes where the product cannot come into contact with air. This is either because air contact may degrade the product, for example increasing the dissolved oxygen content in wine, or because the product has a tendency to aerate or foam, which can cause processing problems or delays.

Double-pig systems, as the name suggests, use two separate pigs. The sequence of each pig travelling through the pipe ensures that the system recovers residual product and transfers product efficiently, while always using the pigs to seal the product from air in the pipe, so avoiding air contact and aeration.



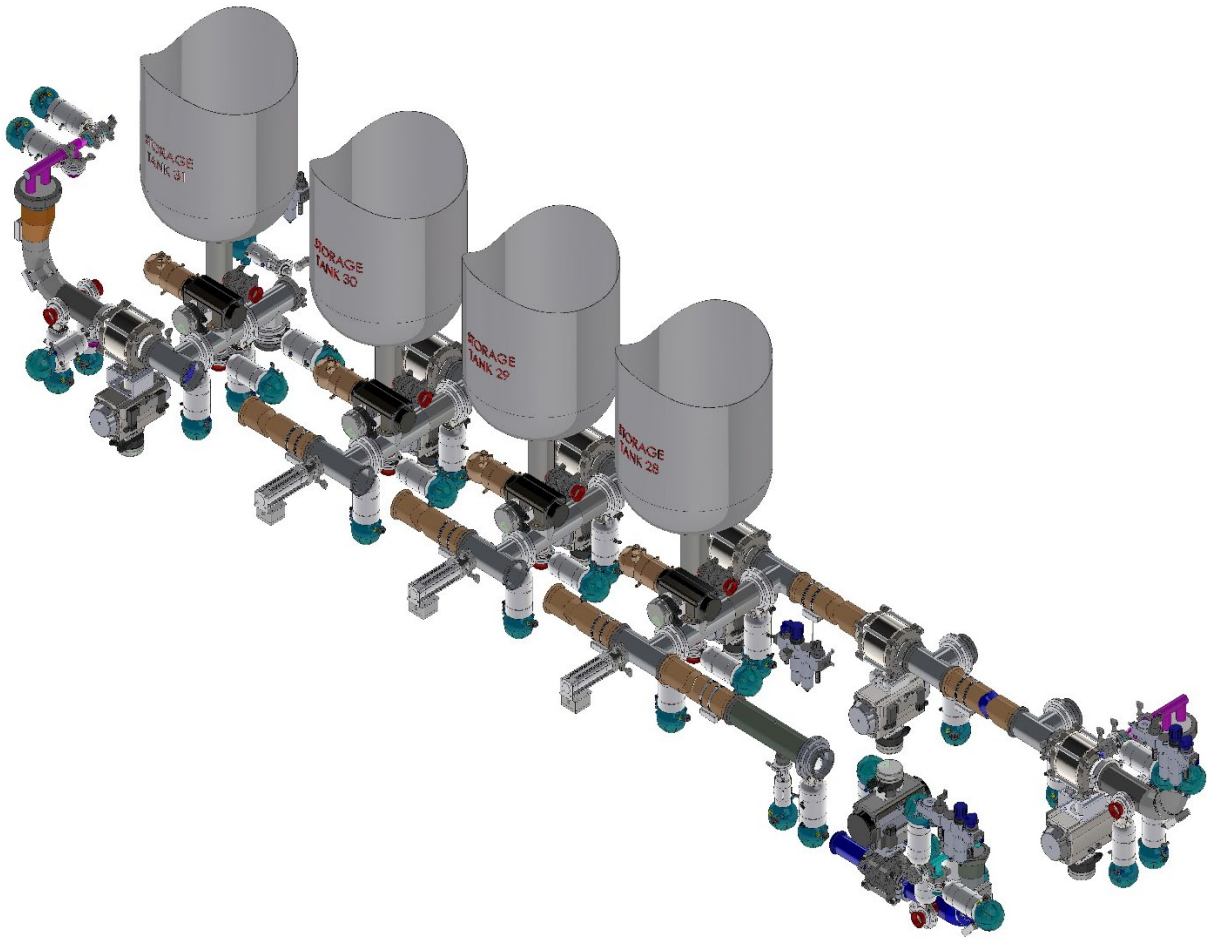
Double-pig System

Tank Drop-off

Tank drop-off systems are similar to single-pig systems, but incorporate multiple destinations on the same line, rather than a single destination.

There is no limit on the number of drop-offs. After transfer to a tank, the automatic pigging sequence sends a pig to a blocking valve at the appropriate tank. Any blocking valves between the destination and the pig are opened to allow for a clear route. The pig is then returned with the same receive return station used on a single-pig system.

For more detailed information about the different types of pigging system, including video animations, please visit https://www.hps-pigging.com/pigging-system-demonstration-videos/



Tank Drop-off System

Types of Pigs

Pigging systems include a variety of components, including launch and receive stations, specialist valves, propellant supplies, pig detectors, control software, PLCs and so on.
However, one of the most important components is the pig (or pigs). There is a variety of pigs available for sanitary and hygienic applications.

Basic Requirements

For use with chocolate and confectionery, (as well as beverages and other foods), pigs need to be manufactured from food grade material. They should allow cleaning to a reasonable temperature without degradation. While being flexible (so that they can travel around bends and still efficiently recover product), they should ideally be solid; that is, not include caps or assembled components that could catch, break or fall off. Similarly, finned pigs should be avoided. This is because the fins have a tendency to rip or have small pieces break off, while effectively cleaning between the fins is also difficult.

HPS Pigs for Sanitary (Hygienic) Applications

Finned pigs do not work well with chocolate and confectionery products. This is because small amounts of product tend to steadily bypass each fin and build up, sometimes unnoticed. This can cause major operational problems after a relatively short time.

Detection

To enable full automation, pigs should be fully detectable and ideally be provided with a purpose-designed pig detection system. As well as being detectable, they should also be bi-directional.

To reduce contamination risks, pigs should not contain any solid magnets. Solid magnets and other assembled parts can break free from the pig and contaminate the product. For example, HPS pigs have a flexible silicon-based magnetic core, which will not shatter and so avoids the risk of contaminating the processed product with fragments of magnets. This flexibility also means the pig can travel around 1.5 D bends while still efficiently recovering product.

> ***"HPS Pig materials have been validated several times and shown to give longevity of operation and security of product"***
>
> **- P&G**

Reliability and Effectiveness

Like any component, pigs should have a long working life and include a minimum usage guarantee. They should be available in a range of sizes to suit different pipeline specifications. Above all, they should be effective. They should maintain full body contact with the inside of the pipe and recover upwards of 99% of product.

Planning a Pigging System

Compared to many systems, implementing a product recovery or pigging solution is relatively straightforward. However, to ensure your project runs smoothly, here are some factors to consider at the initial stages of your project.

Aims and Objectives

While efficient product recovery is a key driver to most pigging system projects, overall objectives often include reducing environmental impact, streamlining operations, increasing efficiency or profit maximisation. Objectives that are more specific typically include improved pipe cleaning, increasing overall processing speed, and reduction of cleaning product use. However, these objectives vary depending on application. For example, a winery may focus on reducing dissolved oxygen or other contamination risks while transferring their liquids, while a confectionery company that uses high-cost ingredients may focus on eliminating as much product waste as possible.

Being clear about your objectives will ensure your pigging system design meets your needs.

Your Products

As well as the type of products you process, effective pigging system design will require information about typical operating temperatures, viscosity, pumping pressures and so on.

Your Current Operation

Before recommending a pigging solution, it is important to outline to your pigging system provider how your current liquid processing system is set up. For example, how many product sources you have, how many destinations, the approximate distance between each, how you currently clean between changeovers, changeover frequency and so on. It is also important to consider future additions or changes to your processing, and any plans for plant expansion.

Existing Pipeline Infrastructure

The dimensions, material and condition of your existing pipeline infrastructure will directly influence the design of your pigging system. We recommend you consider the following points before implementing a pigging system, as well as during the life of the system:

- ✓ Make sure the length of the pipe you are intending to pig is free from dents and damage.
- ✓ Welds must be clean and have minimal intrusion into the internal bore of the pipe.
- ✓ To prevent progressive damage to the pigged pipe, use anti-vibration cushion-sleeve pipe support clamps instead of metal-on-metal clamps.
- ✓ Instead of rod hangers, use rigid supports such as 'L' frames for the pigged pipe. This will prevent possible movement of the pipe while the sanitary pigs are propelled through it.
- ✓ If you're using compressed air, carbon dioxide or nitrogen to propel the pig, use rigid air pipe rather than flexible air lines (flexible air lines can get distorted and prevent air flow).

Existing Services

There are different ways to propel pigs. The most common is by using compressed air or using a gas such as nitrogen or carbon dioxide. Other methods of propelling pigs include water (although this is unlikely with chocolate) or even the next product to be processed. It is usually preferable to use existing services if possible, so take a note of the compressed air, gas or other services you have available, including their rating.

Special Considerations

There are some special considerations with certain products such as confectionery, wine and beer. For example, with confectionery and chocolate-based products, because the transfer lines are often jacketed (heated to keep the chocolate fluid), the pigging equipment must also be jacketed and able to retain and sustain the heat without degradation. In addition, for chocolate-based confectionery, products such as butter, oil or both are used for flushing. This is instead of water, which is often used when flushing other foodstuffs.

Because too much dissolved oxygen can make wine degrade quickly, the pigging equipment must be designed where the product cannot come into contact with air. This also applies to products which have a tendency to aerate or foam, which can cause processing delays.

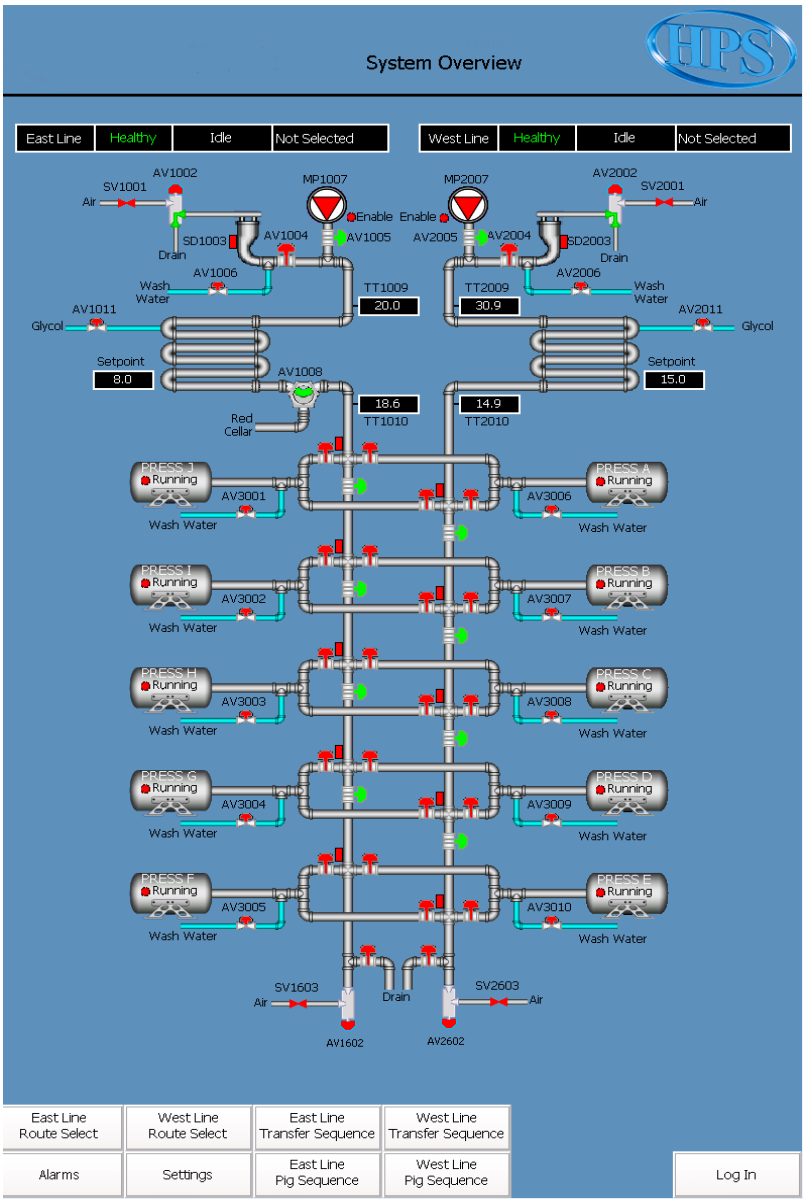
Pigging System Automation

Automated pigging systems are more efficient, more reliable, easier to run and safer than manual systems. You may have your own PLC, SCADA or HMI system specialists that will be able to set up programming and control for you. Alternatively, you can ask your chosen pigging system provider to set up the automation for you.

Pigging system automation systems can be standalone or integrated.

Standalone systems have a separate panel from the existing set up to automatically control the pigging process. Although standalone, it is possible to set up communications to pass data from one PLC to another. It is also possible to hard wire any interlocks and other safety features into the panel.

If there is space on an existing PLC and HMI for integration, it is usually possible to merge the pigging system automation code into it.

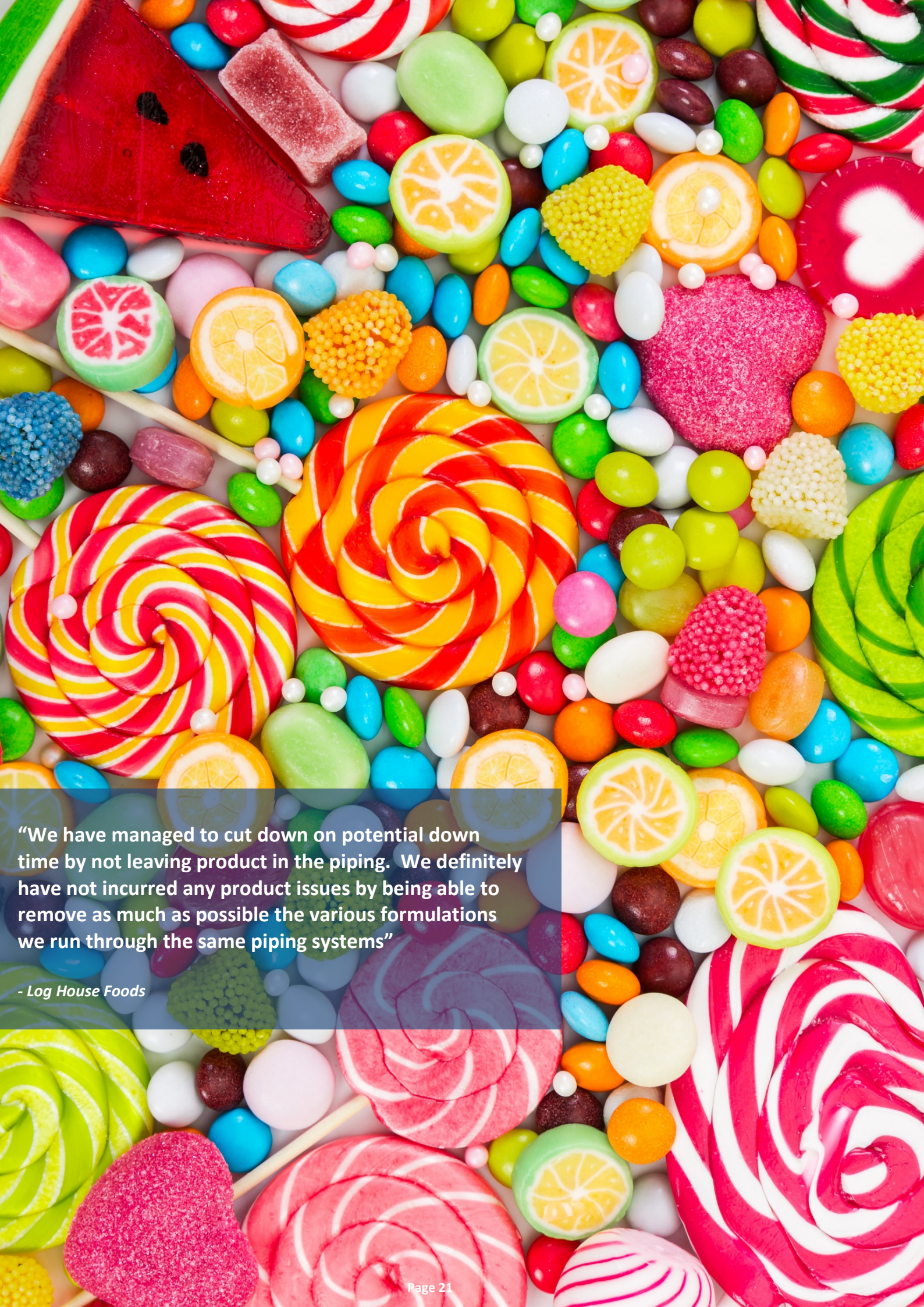


Pigging System Overview on HMI

Use a Specialist

Although the principles of pigging are straightforward, it takes many years of experience and high levels of expertise to successfully design and implement a pigging system. With chocolate for example, it's important to be able to provide jacketed valves, pig launchers, pig receivers and other components, and having them tailored to your specific requirements.

That's why, if you're considering a pigging solution for your organization, you should always work with a specialist sanitary product recovery company.



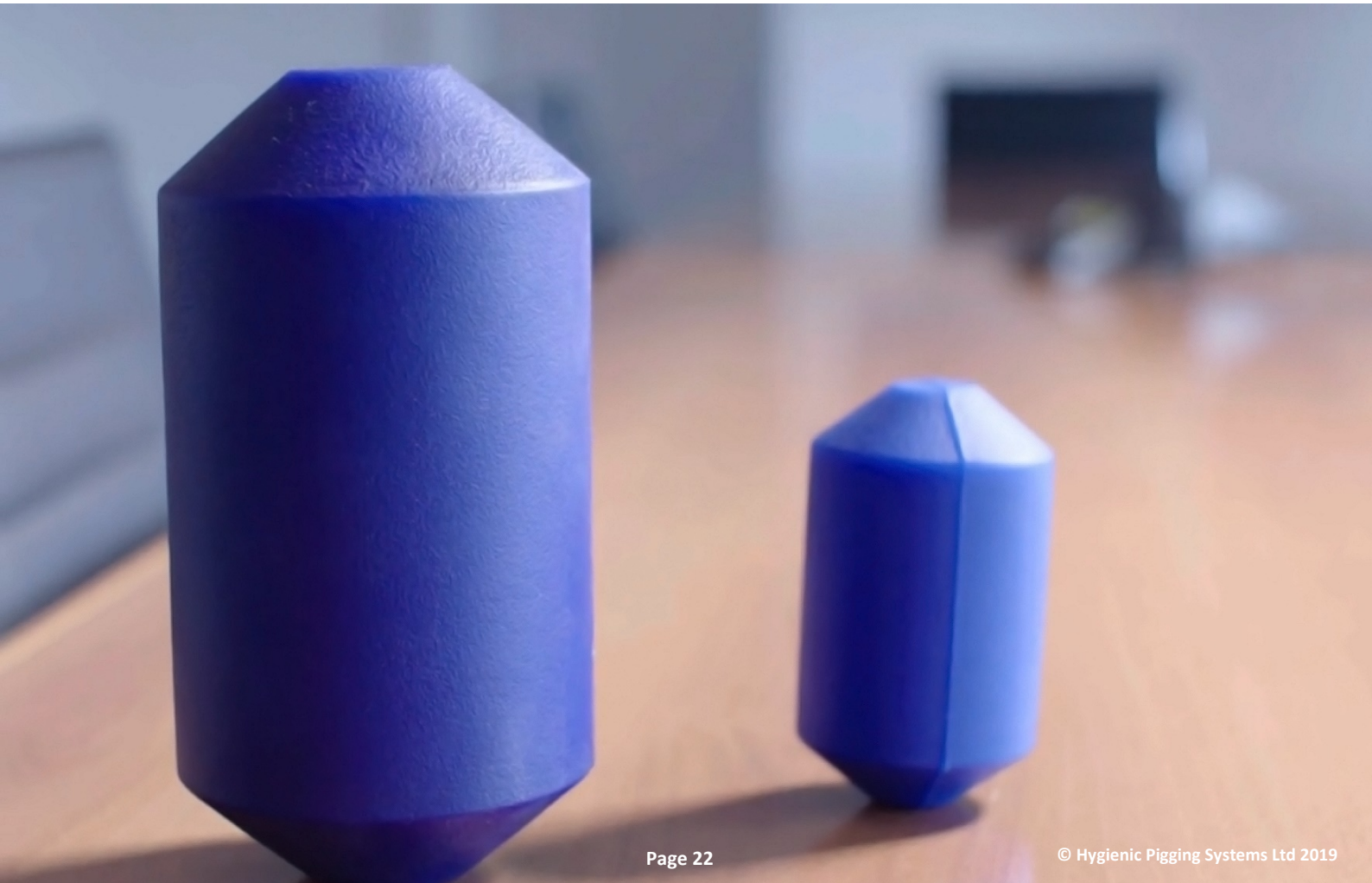
"We have managed to cut down on potential down time by not leaving product in the piping. We definitely have not incurred any product issues by being able to remove as much as possible the various formulations we run through the same piping systems"

- Log House Foods

Further Information

There's a wealth of information about Sanitary Pigging and Product Recovery on the HPS Website. Here are some of the most popular articles:

- **Pigging – What Is It**
- **Benefits of Pigging**
- **Types of Pigging System and Demonstration Videos**
- **Sanitary (Hygienic) Pigs**
- **Pigging System Savings Calculator**
- **How Pigging Helps the Environment (with Infographic)**
- **HPS News and Blog**
- **The Future of Chocolate Production**
- **Facing Challenges in the Chocolate and Confectionery Industry**
- **Pipeline Infrastructure for Pigging Systems**
- **Pigging System Case Studies**
- **Pigging and Product Recovery FAQ's**
- **Myths About Pigging**
- **Get a Pigging System Quote**
- **Pigging System Demonstration Videos**



About HPS Product Recovery Solutions

HPS is the world's leading specialist in pipeline cleaning, liquid product recovery and transfer for manufacturers, producers and processors of confectionery, chocolate and other foods and beverages. This includes sweets, candies, syrups, honeys, butter, fats, food oils, soups, dair, yoghurts, sauces, dips, soft drinks, juices, beer, wine and spirits and many other products.

HPS clients include Kraft, Blommer Chocolate, Ghirardelli, Mars, Nestlé, Mondelez, Campbells, Rachel's, Heinz, Coca-Cola, Britvic, Orlando Wines, E & J Gallo, Unilever, P & G, and many others. There are thousands of HPS systems in use throughout the world.

Established in 1995, HPS has extensive experience in chocolate and confectionery processing which ensures highly efficient, reliable and cost-effective operation.

HPS head office is in the UK. The company also has offices in the US and Australia, and a network of agents and official representatives throughout the world.

In addition to chocolate and confectionery manufacturers, HPS also delivers product recovery, liquid transfer and pigging solutions to beverage, other foods, homecare, personal care, paint, pet food and other industries.

You can't take risks with your processes. That's why HPS engineers will work with you to ensure your solution meets your operational requirements – *before* you deploy it.

For more information, please see our contact details on the next page or click here to find your nearest HPS office, agent or representative.

A Few of Our Clients

MARS incorporated

GHIRARDELLI CHOCOLATE

HARIBO

HERSHEY'S

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Lindt

Blommer CHOCOLATE COMPANY

Kraft

Nestlé Good Food, Good Life

Unilever

LOG HOUSE

McVitie's

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