A Guide to Hygienic Product Recovery (Pigging) for

Food & Beverage Companies

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Summary

For companies that process liquids, hygienic product recovery ("pigging") is one of the most effective ways to improve product yields, reduce waste, speed up production time and have a positive impact on the environment. It is particularly effective, and in wide use, in food and beverage processing and production.

As well as improving efficiency and profits, pigging has additional benefits to beverage producers such as preventing product aeration and foaming, reducing oxidation and cross-contamination risks.

This guide provides an overview of hygienic pigging for the food and beverage industry. It includes an introduction to how pigging works, the benefits of pigging, types of hygienic pigging system and types of pig, and how to plan a pigging project. It also has sources of further information.

Key Statistics and Takeaways:

- The highest quality pigging systems typically recover up to **99.5%** of useable, residual liquids 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 operate semi or fully automatically.
- Pigging is effective - a bottling plant implemented a Pigging System and now saves an average of **256,000 litres of wine** every year.
- In addition to saving product, pigging saves water. For example, an Australian winery saves over **14.4 million litres of water** each year, along with wine savings of approximately **238,000 litres**.
- Savings are significant. A leading soft drinks company massively increased product yield, equating to approximately **48,000 extra cans per week**.
- Pigging reduces waste and its associated costs. A wine processor has **reduced effluent production** by **1,500 litres per bottling** run, which equates to around **500,000 litres per year**.

What Is Pigging?

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

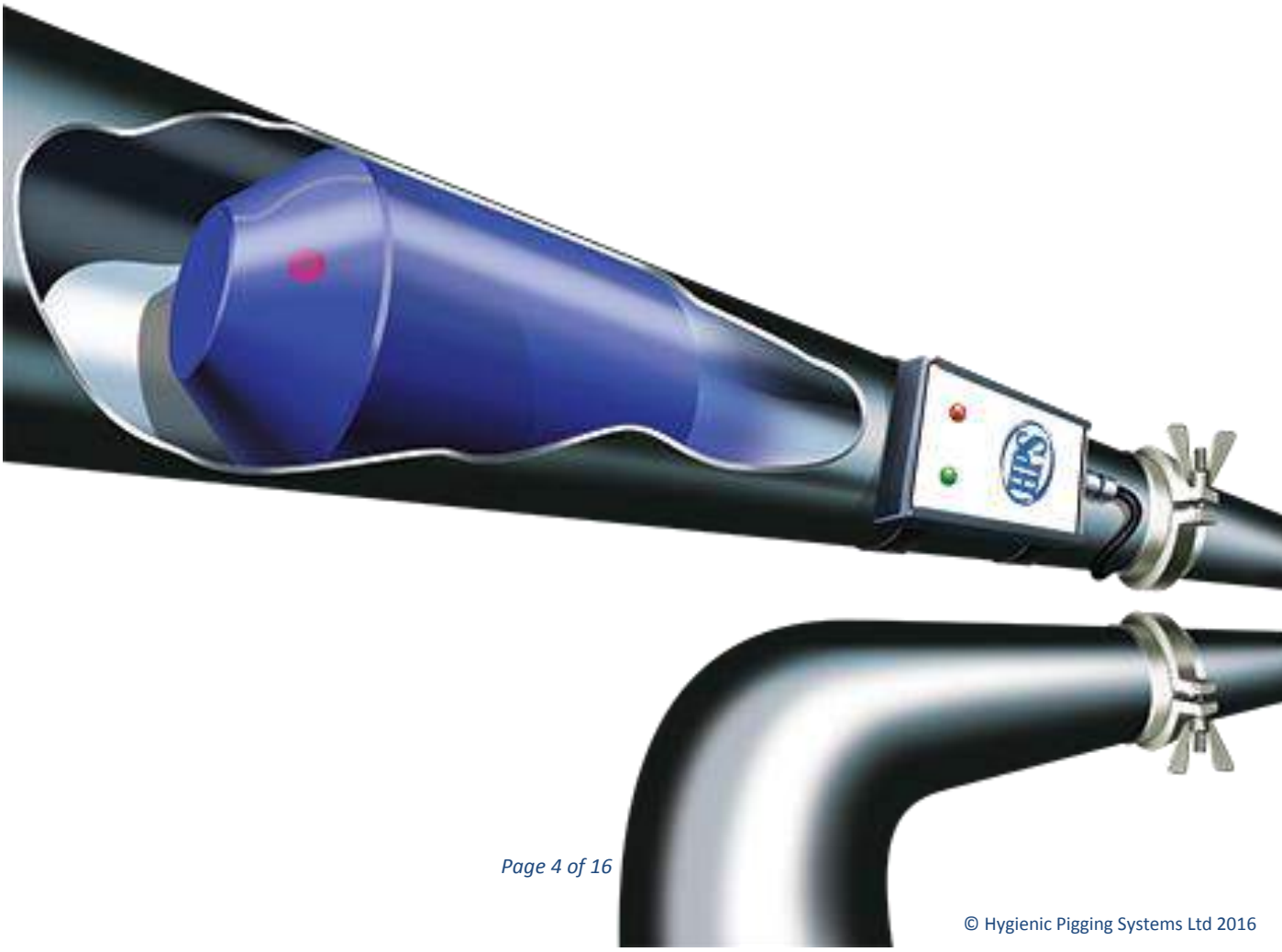
In the food and beverage industry, hygienic pigging recovers residual liquid product from pipes. If it wasn't recovered by pigging, this liquid would go to waste. This product is perfectly useable so can be sold or continue to be processed along with the rest of the batch, rather than being flushed down the drain.

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, clean water or even the next product (depending on the application) provide the pressure. Instead of being flushed 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 water flush and clean-in-place, saving time, labour, water, cleaning fluids and waste disposal costs.



Benefits of Pigging

Hygienic 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**
- **Lower Labour Costs**
- **Less Downtime**
- **Reduced Waste Processing**
- **Lower Cleaning Costs**
- **Faster Changeovers**
- **Reduced Water Usage**
- **Prevention of aeration, foaming and dissolved oxygen**
- **Positive Environmental Impact**
- **Smaller Carbon Footprint**

Increased Profits, 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 second 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.

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 of the product. The more viscous the product, the more residue there is.

As an example, HPS provided three fully automatic pigging systems to one of the UK plants of the manufacturers of one of the world's most popular fizzy drinks. Each system delivers product from any one of four tanks to a filling machine.

The three pigging systems delivered a 4% increase in product yield, equating to 48,000 extra cans per week. Similarly, a wine bottling plant implemented a pigging system and now saves an average of 256,000 litres of wine every year.

Faster Changeover

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, increased use of water for flush outs 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 colour, flavour or perfume it is often possible to follow on immediately with the next product after pigging, eliminating the need for flushing altogether.

Reduced Water Usage

Often 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.

For example, a well-known wine producer, which has a number of HPS systems in place, estimates that they are finding water savings of around 40 million litres per year (in addition to wine savings of 440,000 litres per year).

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, hygienic product recovery and pigging systems directly reduce waste processing costs. For example, an Australian winery has reduced effluent production by 1,500 litres per bottling run, which equates to around 500,000 litres per year.

Lower Cleaning and Labour Costs

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

Prevention of Aeration, Foaming and Dissolved Oxygen

As a liquid travels through a pipeline, the flow is usually turbulent. If there's air in the pipe, it can mix with the liquid, and the liquid becomes aerated. With certain liquids, even a small amount of air or gas can cause foaming. Others can be degraded or rendered unusable if they come into contact with air. Dissolved oxygen is a particular problem with wine, for example.

One of the most effective ways to prevent liquid coming in to contact with air during processing is to use a double-pig system.

Positive Environmental Impact

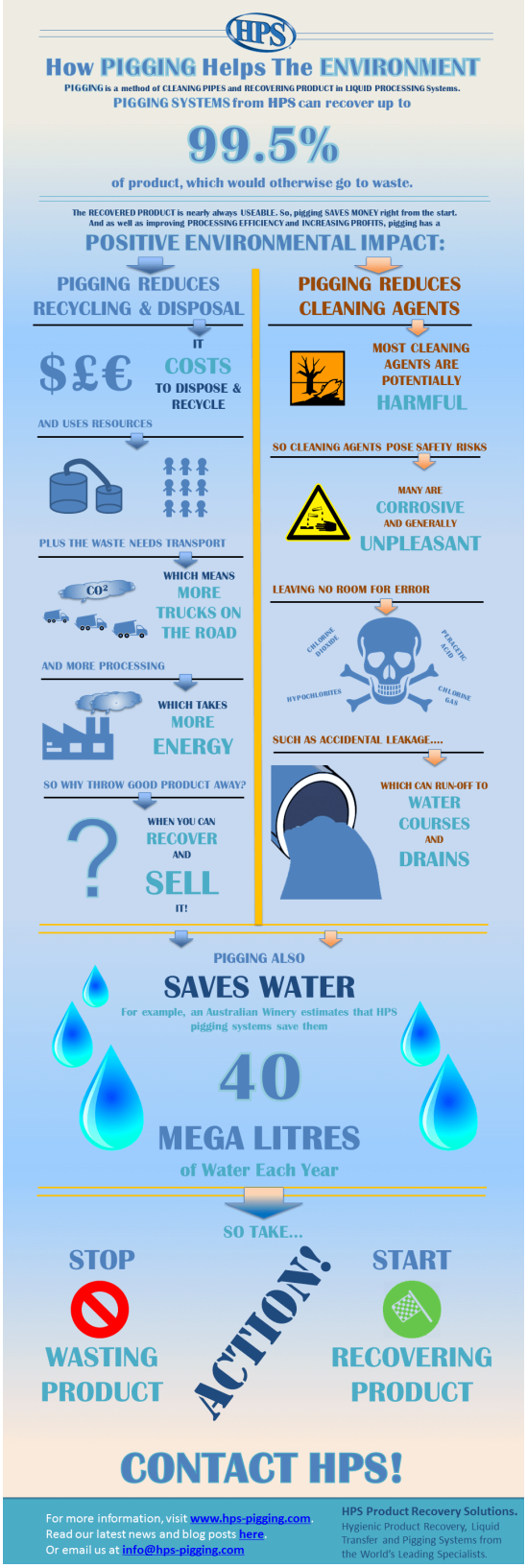
Many food and beverage companies have strong environmental initiatives. Therefore, the positive environmental impact of pigging is a key benefit to many food and beverage producers and processors.

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

The costs of removal or treatment of waste from plants has become a major expense to many liquid processing companies. Additionally, changes in legislation and environmental policies can lead to companies 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 water 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

Types of Pigging System

Pigging systems can be deployed on existing plant, as well as new projects.

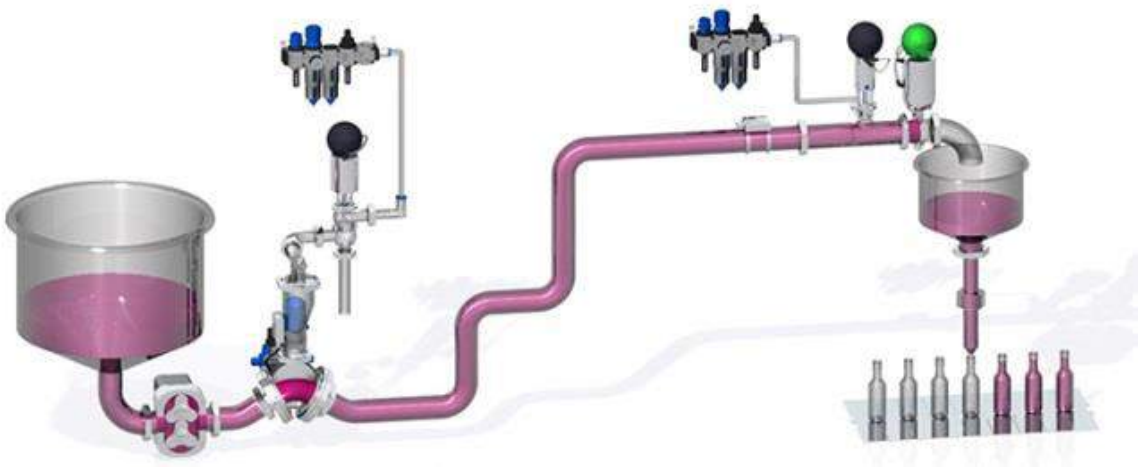
Because every company's processes and systems are different, every pigging system implementation is bespoke; there's no such thing as an effective 'off-the-shelf' hygienic pigging system. However in food and beverage processing, pigging systems tend to fall in to one of three categories:

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

These systems are controlled either manually, semi-automatically or fully-automatically. However, most installations are now automated, particularly double-pig and tank drop-off systems.

Single-Pig Systems

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 Systems

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.

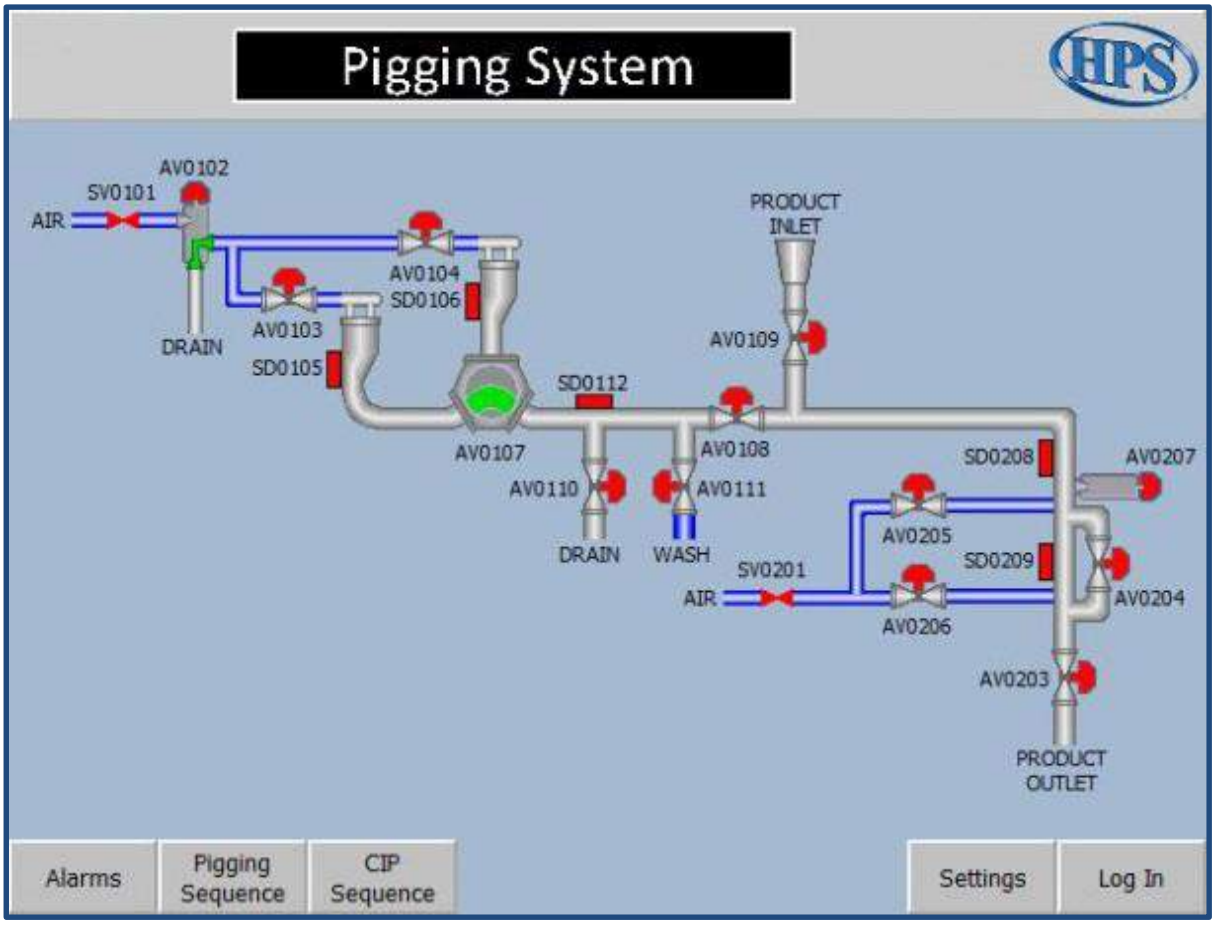
Double-pig systems, as the name suggests, use two separate pigs. The sequence of each pig travelling through the pipe ensures that the system recovers residual product and transfers product efficiently, while always using the pigs to seal the product from air in the pipe, so avoiding air contact and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

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 amount 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 http://www.hps-pigging.com/pigging-system-demonstration-videos/



Pigging System HMI Screenshot

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 hygienic and sanitary applications.

Basic Requirements

For use with beverages and food, pigs need to be manufactured from food grade material. They should allow steam 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.

Hygienic Pigs

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.

Reliability and Effectiveness

Like any component, pigs should have a long working life and include and 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 water and cleaning fluid 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 food 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 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 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.

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 hygienic 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).

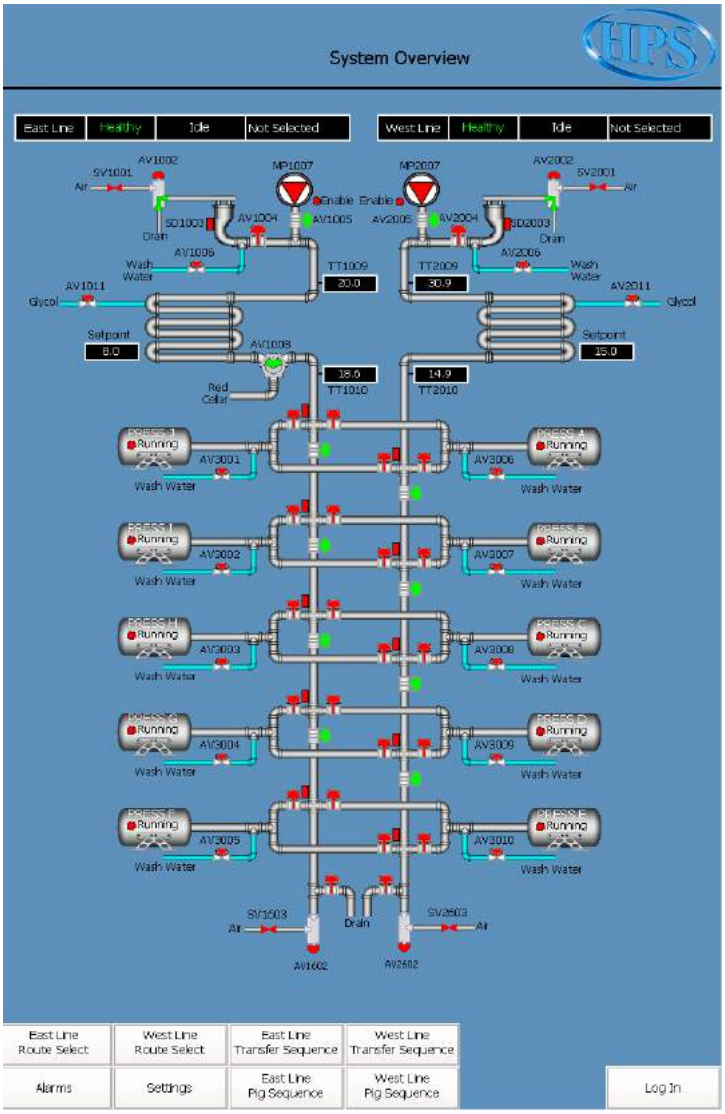
Pigging System Automation

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.



Winery 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. That’s why, if you’re considering a pigging solution for your organisation, you should always work with a specialist hygienic product recovery company.

Further Information

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

- **What is Pigging**
- **Benefits of Pigging**
- **Types of Pigging System and Demonstration Videos**
- **Hygienic Pigs**
- **Pigging System Savings Calculator**
- **How Pigging Helps the Environment (with Infographic)**
- **Food and Drink Production – the Importance of Sustainability**
- **How To Eliminate Aeration and Foaming**
- **Pipeline infrastructure for pigging systems**
- **Clean-in-place (CIP) and Pigging**
- **Pigging System Case Studies**
- **Pigging and Product Recovery FAQ's**
- **Request a Pigging System Quote**

About HPS Product Recovery Solutions

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

HPS clients include Kraft, Campbells, Rachels, Heinz, Coca-Cola, Britvic, Orlando Wines, E & J Gallo, Glenmorangie, Unilever, P & G, and many others. There are over 1,200 HPS systems in use throughout the world.

Established in 1999, HPS has extensive experience in food and beverage 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 food and beverage companies, HPS also delivers product recovery, liquid transfer and pigging solutions to 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.

Piggable Liquid Transfer and Distribution System

Contact HPS

To improve the efficiency and effectiveness of your beverage processing or production operation, please contact HPS at:

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