

## Product Recovery Systems (Pigging Systems) in the Processing Industries

It is economically beneficial to the processing industries to remove and recover product remaining in the pipelines of the process system. Product recovery (“pigging”) has been used in the petrochemical industry for over thirty years and today the method has been adopted by the chemical, pharmaceutical, cosmetic, dairy, food and beverage industries, to recover products and to clean piping networks. A&B Process Systems have both designed and coordinated the incorporation of product recovery systems in the process industries. The design necessarily considers several factors, e.g., the ability to consistently recover the product efficiently, ease of maintenance and the inclusion of both automatic and manual controls. The “pig” (so called because of the squealing noise it makes as it moves through the pipes) is a flexible projectile, driven at high speeds by air or nitrogen or by a liquid medium such as water or cleaning solutions.

It should be remembered that processes evolve and change with time, whereas the product recovery systems often remain the same. A&B Process Systems recommend that these systems be reviewed periodically and modified to maintain or improve the performance.

### Advantages of Product Recovery Systems

The incorporation of a product recovery system into a process line realizes several advantages;

- (a) the yield of valuable product is increased,
- (b) the loadings of waste material in the effluent streams are reduced, making it easier for the plant to comply with environmental regulations,
- (c) the costs associated with Clean-in-Place (CIP) processes are significantly reduced,
- (d) the changeover between products is faster and
- (e) cross-contamination is minimized and product quality is improved, particularly at start-up.

### Designing a Product Recovery System

A basic pigging system does not require a large expenditure of capital and therefore it is unnecessary to “cut corners” in the design phase. Several factors are considered to be important to the design of a product recovery system;

- (a) the system should provide consistent recovery of the products with high efficiency,
- (b) the physical properties of the fluid products, e.g., the viscosity and lubricity, will determine the pressures required to propel the “pig” through the pipelines,
- (c) the pig should be capable of traversing complex and compact piping layouts,
- (d) a “closed loop” system is usually preferred to ensure cleanliness and to allow complete CIP capabilities for all the components,
- (e) the system should be easily maintained and
- (f) both automatic and manual controls should be available.

A product recovery system may be designed to be either unidirectional or bi-directional, but both will contain a launcher (from which the pig is propelled through the pipelines) and a catcher (to catch the pig at the end of the run). The bi-directional system contains two launchers and two receivers, one at each end of the piping network. The body of the launcher unit should be designed to allow rotation out of the pipeline, facilitating maintenance on the system and/or replacement of the pig. Rails and bars should be welded across the tees and Y-pieces in the piping system, to guide the pig past the alternate passages. The piping network is usually fitted with a pressure gauge, product drain and pressure/regulator flow control valve.

It may be advantageous to some processes to design a dual pig system, in which the first pig precedes the flow of product being recovered, typically to minimize foaming or oxidative degradation. The second pig serves to recover the product.

Many pigging systems include a pig detector to facilitate interface with a PLC in automated designs.. Pressure transmitters, magnetic flowmeters and hydraulic shock absorbers may be required to allow full automation of the pigging and CIP operations.

### Types of Pigs

The projectiles have evolved into fairly sophisticated devices, presently being available in a variety of lengths, diameters, shapes and configurations, as well as being fabricated from a range of elastomeric materials. The pigs today are designed to negotiate complex piping networks, traversing tees, Y-pieces, bends, valves and dual-diameter piping.

Within the processing industries there are four types of pig that are preferred – the power brush scrapper pig, the solid cast closed cell pig, the wiping pig and the food grade pig. The power brush scrapper pig is a foam body, urethane coated projectile, with either flame-hardened steel bristles or nylon bristles. This type of pig is frequently used in commissioning a new pipeline network, in order to reduce wear and tear on the process pigs used in normal operations. The solid cast closed cell pig is typically used to displace the product from the pipelines. It is fabricated from either standard or chemically resistant elastomers, depending upon the nature of the product in the process. Wiping pigs are open cell foam structures, ranging in density from 2 to 7 pounds per cubic foot. This type of pig will be used to service piping networks not originally designed to allow pigging.

The urethane pig tends to be the most popular, largely due to its' low cost. This polymer is readily adapted to changing the architecture, has good wear characteristics and can be compounded with materials such as Teflon. Although the temperature limitation for the urethane pig is approximately 200°F, this limitation is only of concern in bi-directional pigging systems, where the pig remains in the piping network. Other elastomers such as EPDM and Viton can safely be used at higher temperatures and may offer better chemical resistance than the urethanes in some products.



A different approach to “pigging” has been developed at the University of Bristol in the United Kingdom. The method uses an ice-water slurry, which is forced through the piping network to scrape the surfaces clean. The slurry does not become trapped in the pipeline and is entirely food-safe. The so-called “ice pigging” has found application in the food industry in Europe.

### The Role of A&B Process Systems

A&B Process Systems have both designed and coordinated the incorporation of stainless steel product recovery systems for the chemical, pharmaceutical, dairy, food and beverage industries, these systems usually being part of a larger process system. The engineers at A&B are well aware of the critical factors that must be considered in the design of pigging systems. A&B also like to point out that processes evolve and change with time, so that it is recommended that the product recovery systems be reviewed periodically to maintain or improve the performance.