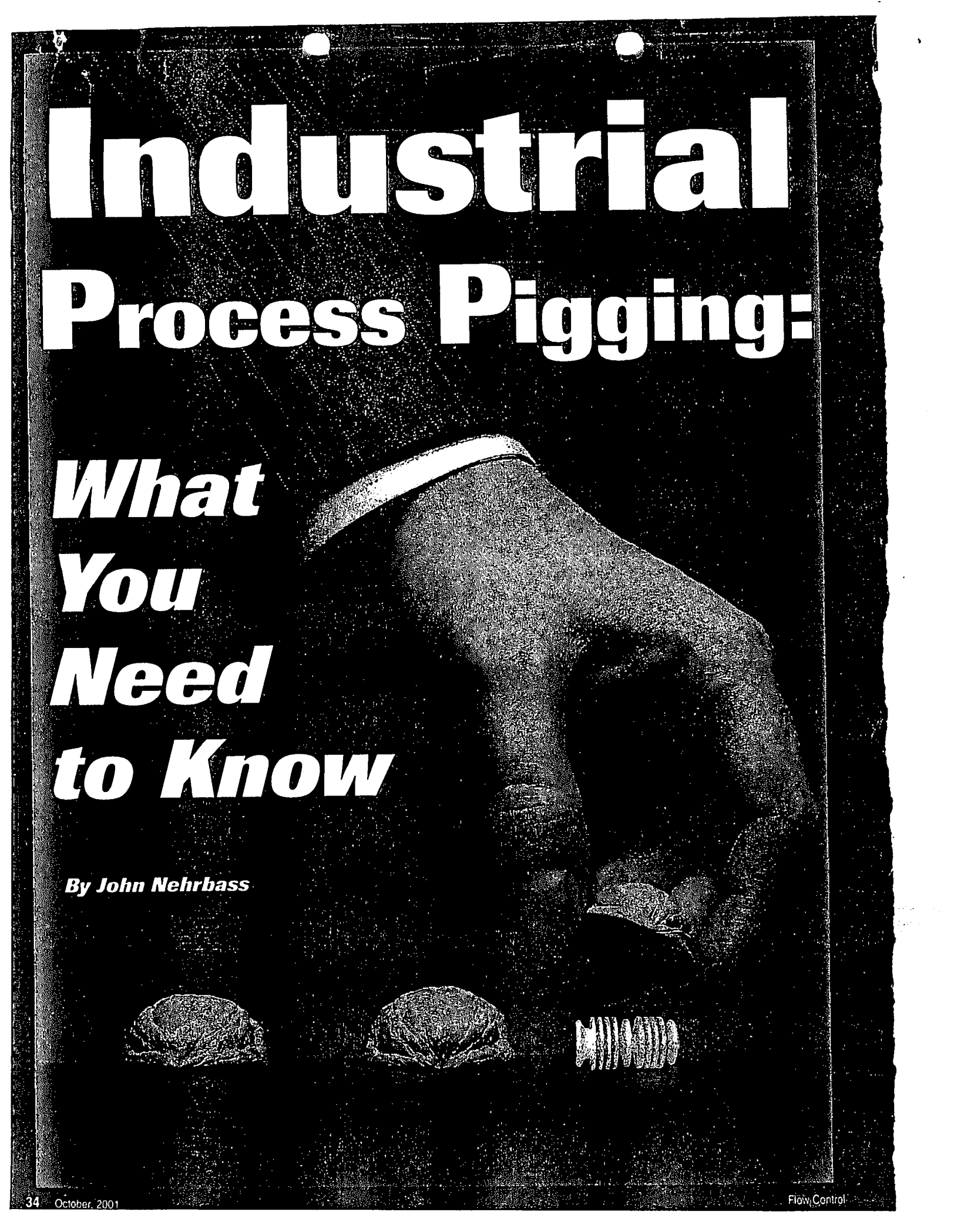
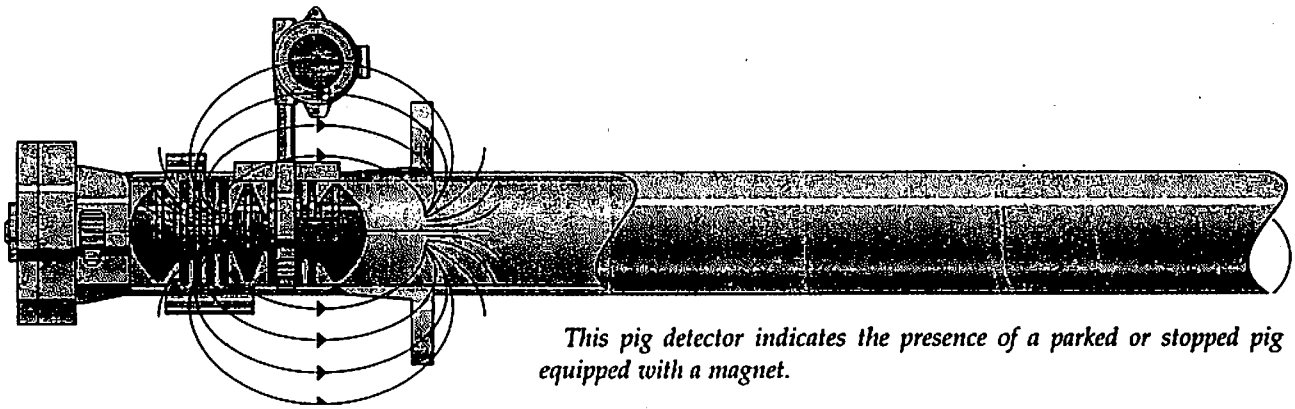
Industrial Process Pigging:

What You Need to Know



By John Nehrbass

If you don't have one already, you would do well to consider a pigging program implemented on a regular basis.



This pig detector indicates the presence of a parked or stopped pig equipped with a magnet.

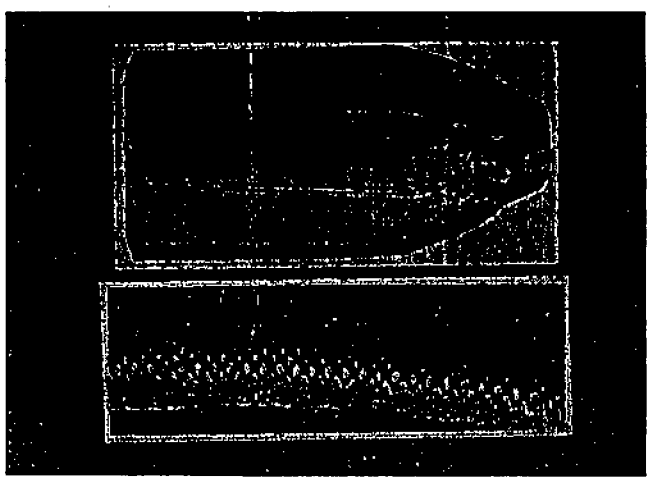
Simply put, pipe pigging is the propelling of a flexible elastomer projectile called a pig through a piping system. The pig can be driven with plant air, nitrogen gas, a liquid medium (such as water) or a Clean-In-Place solution, depending upon the process requirements. The term pig comes from the fact that when pigging a product line, which carries a product with poor lubricating qualities, this lack of lubrication causes the projectile to squeal just like a pig.

Usage – Who and Why?

Industries such as chemical process, food and pharmaceutical are prime users of pigging systems. Pigging is used for cleaning in the initial phase of a Clean-In-Place operation. It is used to capture valuable product between product changeovers, and finally it is sometimes used as a simple inexpensive batching system acting as single or multiple positive displacement measurement system without all of the moving parts.

Motivation – The Bottom Line

If all of your process lines are dedicated, then pigging is mostly confined to cleaning or simple evacuation at the end of a run. However, if your process lines are time shared, then pigging becomes a very important part of your operation. This is especially true where you are changing recipes, as pigging will reduce downtime between product runs. It will save on valuable CIP chemicals, reduce waste to discharge, or haulage and most importantly, capture your valuable product in a saleable condition. Moreover, considering environmental regulations, it behooves users to consider a pigging program implemented on a regular basis.



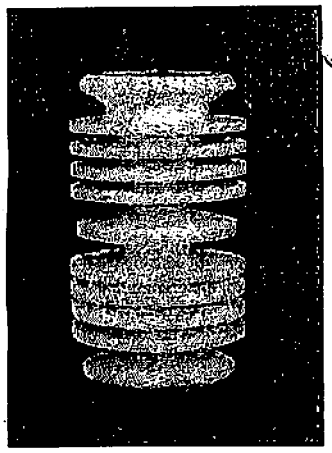
The power brush scrapper pig comes in the same diameters and is always made of open cell urethane. It will have Nylon bristles for cleaning stainless steel, and flame-hardened steel bristles for cleaning carbon steel. Actually, it does more than cleaning, it is for taking off the rough places caused by welding, etc. It is used prior to start-up, and maybe once or twice a year, if a product tends to build up over time.

Pig Types – What's Out There?

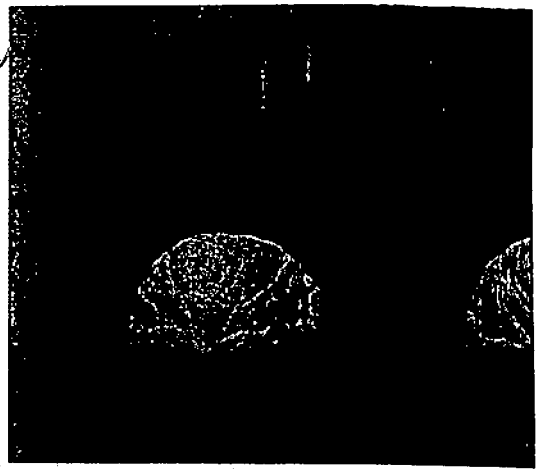
If you are commissioning a new pipeline network, it is best to start with a *power brush scrapper pig*. This is a foam body urethane coated pig with flame-hardened steel bristles for carbon steel systems, or Nylon bristles for stainless systems. Driving this pig through the system prior to start-up will save much wear and tear on the process pigs to be used during future normal operations.

The *solid cast closed cell pig* is the process operations displacement pig. Standard elastomers available are polyurethane both standard and chemical resistant, Nitrile, Viton, Neoprene, EPDM and other compounded materials.

Wiping pigs are urethane open cell foam pigs of varying density (2 through 7 lbs. per cubic foot), often used as



The SUD pig runs in diameters from 1.5, 2, 3, 4 and 6 inch for most industrial applications. The most common material is urethane, chemical resistant urethane, EPDM, Viton, Nitrile and Neoprene. Neoprene and urethane can be food grade.

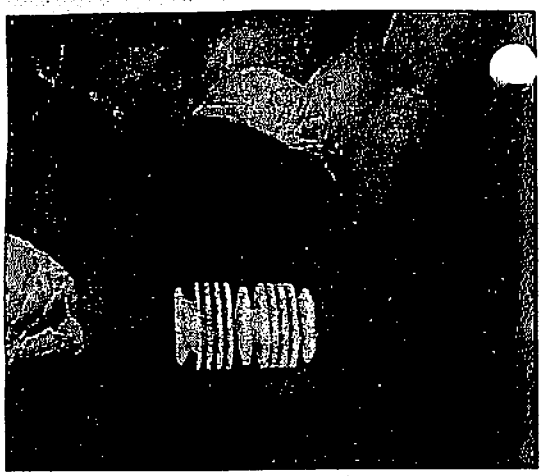


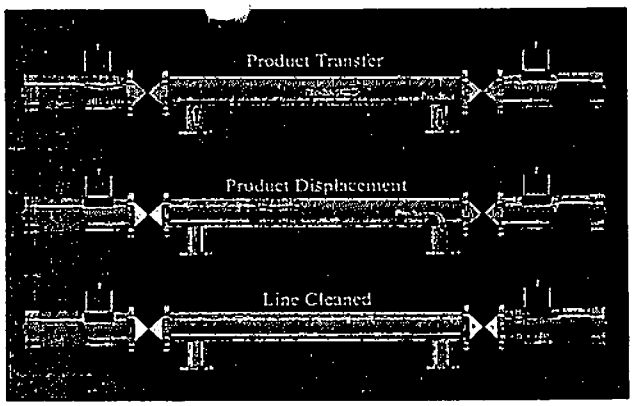
a follow-up swap when changing, for example, from a dark color product to a light color product. Open cell foam pigs are also pressed into service in piping networks, which were not originally designed for pigging.

Food grade pigs are usually confined to white polyurethane or white Neoprene.

Generally, the urethane pig is the most popular for a number of reasons, cost being foremost. Urethane lends itself to ease of changing the architecture, durometer and compounding with materials, such as Teflon. Further, urethane pigs can be compounded to prevent the plastizers from being leached out by certain products that might contain amines or other leaching chemicals. Urethane pigs are limited to about 200°F continuous operating temperature. This limitation only applies to a bi-directional system where the pig remains in the system. In a unidirectional system where the pig is removed after each run, this temperature limitation is not as stringent.

Temperature limitations for Neoprene, Nitrile, EPDM and Viton are 230, 250, 300 and 400°F respectively. These materials might be selected when urethane or chemical resistant urethane is not chemically compatible with the product being pigged. Again, exposure time comes into play. Does the pig remain continuously in the system in contact with the product, or as with a unidirectional system, is it removed after each pigging run? The correct approach on this issue is a simple soak test to look for swelling or color change, which usually indicates leaching out of the plastizers.





A launcher/receiver system, right.

Existing Systems

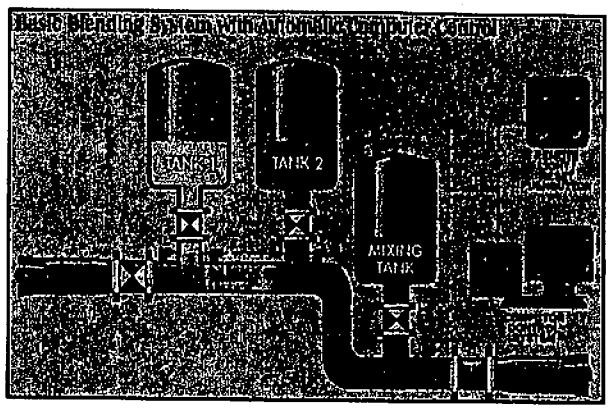
As operations change with time, and the system remains fixed, problems can unfold. A survey of the pigging system and its operation can quite often result in improved performance merely by addressing pig design, thus avoiding expensive piping modifications. However, at times, a survey can uncover a situation where the plant air filter regulators used for launching the pigs have been undersized, forcing the operators to boost the pressure higher than required in an attempt to compensate for the lack of sufficient volume. Again, this is not a serious problem, as filter regulators are relatively inexpensive. The correct pressure with sufficient volume of drive gas gives operations the best pig velocity control. This is most important on the return run for bi-directional systems, where the pig is in a gas-to-gas situation. Generally, the operation should drive the pig at 3 to 5 feet per second during the fluid displacement run, and to extend pig life, no more than 5 to 7 feet per second on the return run to home station.

Designing a Grass-Roots System

A basic product recovery pigging system does not require a high capital expenditure. Therefore, there is no need to "cut corners" with the design, as any initial savings will be lost to higher operating labor costs in a short period of time.

With either a unidirectional or bi-directional system, there must be a *launcher* to launch the pig for the product displacement run and a *receiver* to catch the pig at the end of this run. A bi-directional system merely has two

identical launcher/receivers at each end of the piping network. The "piping network" may be made up of carbon steel, stainless steel tubing, hose or a polymer, such as high-density polyethylene tubing. Launcher/receivers are normally offered in carbon steel, stainless steel or in some cases, they might be fabricated out a polymer, such as HDPE. Launchers and receivers are offered with blind flange closures or the less labor intensive hinged quick opening closures. Each launcher/receiver is usually fitted with a pressure gauge, a product drain and a pressure/regulator flow control valve. For situations where pigging is on an occasional basis, there are portable launchers available on the market. For numerous systems, a pig detector is mounted in close proximity to both ends of the piping network. This takes the guesswork out of where the pig is. It further lends itself to interfacing with a PLC when the time comes to automate the process. A pig detector is either intrusive or non-intrusive. The latter type requires that a magnet be imbedded in the process pig to trip the switch. Again, a portable pig detector is available to the user.



A basic blending system with automatic computer control. This arrangement can be used with manual or automated, one-way or bi-directional operations. Passage of the pig is shown by a local indicator light and by an output signal to a pig control panel or integrated with the plant's control system.

All Tees, Y type fittings, etc. must have rails or bars welded across to guide the pig past these alternate passages. All inline valves must be of the full port variety. In more complex systems, pig switches are used to divert the pig from one path to another. Additional complexities would be the addition of flow transfer panels or a "scramble box" to allow maximum flexibility between raw material storage tanks and the product mixing or compounding areas. Finally, pressure transmitters and piggable inline mass flowmeters, magnetic flowmeters and inline hydraulic shock absorbers can be added for full automation of pigging, CIP, product compounding and batch sizing. It can be all computer controlled to match a recipe. The inline hydraulic shock absorber is not only piggable, but lends it self to a CIP operation, as well. This is a must for canning production lines with the start stop sign wave flow characteristic of the system.

Finally, let us not forget Mr. Murphy and his laws. When designing a pigging system, always design for a worst-case situation. On a gas driven system, which most are, make a provision with fittings to hydraulically drive a stuck pig all the way through the system.

This takes the fear out of the equation.FC

About the Author

John Nehrbass, P.E., has a B.S. degree in engineering from Bradley University, and an M.B.A from Loyola University. He has 20 years of experience in industrial, petroleum and petrochemical flow control and flow measurement. He is the former Asia/Pacific manager with Emerson Process Management — Singapore. Currently, he works for Fluid Recovery Systems (Palatine, IL).