Introducing FloCEP™

PROmotion® Technology Applications

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FloCEP™

PROmotion® Technology Applications

*Designed to optimise plant OPEX by addressing the following common concerns:*

- Maintenance - excessive wear
- Process - recovery, losses, sub-optimal grade
- Process - classification efficiency, milling power
- Process - capacity restriction due to underutilized equipment efficiency

*by using patented technology that addresses slurry segregation:*

- Easy to retrofit
- Cost effective
- Proven on full industrial scale
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What is “PROmotion?"

**PROmotion** is a patented technology platform that addresses the root cause of non-homogeneous flow within pipes containing multiphase mixtures. The technology addresses this problem by creating even flow distribution in two phase and three phase pipe flows such as mineral slurries and mixtures of oil, water and gas streams.

PROmotion is the core science behind the following industrial applications:

- Improved In-Process Flow Splitting
- Reduced Pipe Bend Wear
- Process Additive Dose Optimisation
- Improved Sampling Integrity

**Where and Why is Local Homogenisation Important?**

The term *multiphase pipe flow* refers to the simultaneous flow of more than one material through a pipe.

Typical examples are the flow of mineral particles and water (slurry), and the simultaneous flow of oil, gas, water and sand in a pipe from an oil well - the different separately identifiable materials within the flowing material are referred to as *phases*. The simplest state for a multiphase is when it is uniformly well mixed (described more accurately as *pseudo-homogenous*); when the flow is in this state any samples, wherever they are taken at various points across the diameter of the pipe, will be (essentially) the same.

In many (not all) situations multiphase flows are in a pseudo-homogeneous state at the point where the flows enter a pipe (e.g., from a pump). However, the pseudo-homogenous state becomes unstable; as flow passes downstream, the phases tend to separate (segregate).

Segregation occurs because each of the various phases in the multiphase flow has a different density and so the various phases are subject to differential accelerative forces (i.e., the more dense materials tend to settle out). As a result of this inherent tendency for segregation to occur, the multiphase flow becomes non-homogeneous (non-uniform). The differential effect is increased, due to gravity, when the flow is vertical, or when the flow is subject to centrifugal acceleration, as in a bend.
This inherent tendency for multiphase flows to become segregated can cause significant problems in some very common situations:

- With flow splitters and distribution manifolds - non-uniformity can lead to different phase proportions or densities in the various outlet streams.
- With slurry flow - segregation leads to high rates of erosive wear on the pipe bends, where the abrasive mineral particles become concentrated.
- At points where it is important to establish and maintain uniform concentrations of dissolved chemicals in a fluid phase - such as points where additions are made to the flow at a proportional rate (e.g., additions of acids or flocculants to slurries), where non-uniformity leads directly to corresponding non-uniform concentrations of the addition in the fluid phase.
- Sampling and instrument readings

Typically occurring in plants that pump mineral or chemical slurries:

This becomes a “problem” when the process stream is subject to:

- Significant change in direction
- Flow is split to supply other separate unit processes (such as filters, cyclones etc)

This has become universally accepted as unavoidable in the past.

*Such problems can be addressed by homogenising the flow immediately upstream of the point where segregation must be avoided. This can be achieved by replacing a short section of pipe with a PROmotion-based flow conditioning unit.*

The value and advantage of using PROmotion-based flow conditioning is gained by applying just at *those particular points* where segregation materially degrades processing or transfer operations.
What is FloCEP?

FloCEP Pty Ltd is a technology-based business that delivers these PROmotion applications to industry, providing:

- Customer interaction and solutions formulation
- Specific built-to-measure application equipment
- Equipment manufacture
- On-site installation and commissioning assistance
- Commercial options to customers in the application of PROmotion technologies such as capital avoidance

Why Can You Benefit from FloCEP Products?

Multiphase phase mixtures feature throughout industry. These include mineral or ‘hydrate’ slurry, fluidised solids-in-gas stream, or mixture fluids (e.g., oil, water and gas). When these flow within a pipe, the effects of gravity, often combined with centrifugal forces result in segregation of the different phase components. Segregation may be evident as stratification and surging within the pipe, but even when it is not so evident; the non-homogeneity induced by this inherent tendency has a significant impact on process performance.

Non-homogeneous flow results in

- Pipe erosion
- Unequal splitting of flows in distribution manifolds
- Variations in the loading of the various phases throughout downstream operations

Industry has focused on remedies that deal with these effects rather than attempting to address the cause - the non-homogeneity within the actual transported stream.

FloCEP’s suite of PROmotion Technology applications

The key common feature of FloCEP’s suite of PROmotion Technology applications is that they create local homogenisation (to be accurate: pseudo-homogenisation) of the flow at critical points where multiphase flows tend to become segregated. This segregation degrades plant performance and plant longevity. The core science of this technology is behind all PROmotion applications. FloCEP adapts the technology to suit different situations for industry.

Situations where such inherent segregation impairs performance include:

- Points where multiphase flows need to split through manifolds to feed multiple parallel downstream processes;
- Points where representative samples or instrument readings are to be taken from multiphase flows;
- Where instruments that use in-line or irradiation sensors measure flow, density etc
- Flow distributors for feeding hydrocyclone clusters or other multi-unit equipment such as spirals;
FloCEP’s suite of PROmotion Technology applications (cont’d)

Situations where such inherent segregation impairs performance include (cont’d):

- At critical pipe bends where segregation of slurry particles causes intractably high rates of abrasive wear.
- In regions of pipes and bends where abrasion from solid-phase particles is important in limiting scale formation.
- At inlets to slurry pumps, where segregated flows causes rapid localised wear.
- Where chemical injections are made to multiphase flows and need to be mixed immediately for efficient dosing.

FloCEP products can easily be retro-fitted to existing plant and equipment. They are made to standard piping specifications, and can usually be installed as bolt-in replacements for existing components. These are not static mixers as industry knows them. They do not span the piping internal diameter. They are static devices, not requiring power or control instrumentation and they do not require increased pumping pressure.

- PROmotion Technology applications generally make use of standard piping components combined with a custom-manufactured internal element designed to a specific shape to induce self-mixing of the flow. The use of standard fittings means in many applications FloCEP products can replace existing components in existing pipework.
- Each FloCEP product is specified to be appropriate for a particular application. Where standard products are not suitable, FloCEP proprietary software is used to design a customized solution.

PROmotion Applications - Plant Proven

The two applications that are already proven and now in full time, full scale use in production operations are:

- Improved In-Process Flow
- Reduced Pipe Bend Wear
- Process Additive Dose
- Improved Sampling Integrity
The FloCEP® Flow Distributor System

The flow distributor system delivered by FloCEP combines two patented elements of the PROmotion technology platform. One technology application pre-conditions the feed flow so that it becomes well mixed (*pseudo-homogenous*) then the second element works within the cyclone cluster to create the conditions required to distribute the flow evenly while in this uniform state. The combination of these two technological applications result in the optimal conditions for production operations involving mixed multi-phase flows.

The FloCEP Flow Distributor delivers its greatest benefit through improved performance of downstream equipment. Significant benefits have also been proven in the form of increased plant uptime, reduced maintenance and reduced operator exposure. The value of the FloCEP Flow Distributor has been proven in production as a replacement feeder for hydrocyclone clusters, and this application provides a prime example of the importance of equal distribution of a multi-phase flow.

The operation of a hydrocyclone unit is heavily influenced by the flow rate and the solids density of the input flow. Conventional distributors (commonly referred to as feed pots) can be adjusted to give equal total flow rates to each unit in the cluster, but do not ensure equal density in each stream. Consequently, instead of operating as a single large-capacity cyclone, the cluster operates as a parallel set of individual units with differing inputs, and hence, differing separation performance.

The effects of this mal-distribution of feed results in unequal classification performance from the separate units in the cluster, and differing wear rates of the replaceable internal components in the individual hydrocyclones. The differential wear occurs as a consequence of the differing concentrations of mineral particles. As well as leading to more frequent shut downs, this differential wear results in the need for frequent operator adjustments.

Unlike conventional feeders, the FloCEP Flow Distributor ensures that these two critical parameters - flow and density - are the same for every unit within the cluster. The result is that the cluster operates as designed. This directly results in increased plant efficiency, in reduced operator intervention and increased plant availability as each individual unit in the cluster wears at the same, predictable rate.

Application of the FloCEP Flow Distributor and PROmotion Flow Conditioner technologies at a gold processing plant in Western Australia has resulted in cyclone maintenance cycles increasing from 3-7 days to 90 days and has created operational costs savings of 95% over the previous system using the same hydrocyclones. During the past 36 months of operation, there has been no need for maintenance on the distributor system.
Beyond these major product applications, customised applications of PROmotion Flow Conditioning technology can assist in achieving production improvements in many other situations where the segregation inherent in multiphase flows impacts adversely on operating costs (efficiency=cost).

The FloCEP Flow Distributor - technology has been developed to reduce maintenance costs and improve productivity in operations where mixed flows must be distributed evenly such as to downstream equipment, and splitting flows of oil or gas containing water, sand or shale particles for downstream processing.

Actual Plant Installations

Designed to install in 12 hour shut window

During installation April 2012

Operational photos 2015

To date these FloCEP unit have required zero maintenance, demonstrating that substantial operational maintenance and PM benefits exist with the production benefits.
The MAXBEND low-wear pipe bend has applications in reducing excessively rapid wear of pipeline bends typically found in mineral processing industries where particles in slurry pipelines cause abrasion. This rapid wear manifests in the need to replace the bend at short intervals, either through unplanned failure, or through the need for frequent planned maintenance. In either case, the consequence is reduced plant availability (increased downtime) and high maintenance costs in both labour and replacement parts. The PROmotion MAXBEND low-wear pipe bend reduces all of these costs.

Such erosive wear of bends is a function of the abrasiveness of the mineral particles, the resistance of the material that forms the inner surface of the bend, and the nature of the interaction between the two. Existing approaches to solving this problem are predominantly based on lining bends with rubber, hard metal or ceramic material. Studies have reported that such problems cost the mining industry a figure in the order of US$10 billion p.a. worldwide.

The Maxbend low-wear pipe bend works in a fundamentally different way. The PROmotion flow conditioning approach, based on pseudo-homogenisation of the slurry flow, changes the nature of the interaction between the particles in the slurry flow and the material that forms the interior of the bend. This creates a far less aggressive wear situation.

The Maxbend low-wear pipe bend has greatly extended the service life on some of the highest maintenance bends, in some cases by more than 15 times (and still going), in multiple successful full-scale plant trials in Western Australia.
Actual Plant Installation 2012

Standard bend installation

Internal erosion pattern after 120 days in service - bend replaced

Internal surface of the MAXbend after 12 months - same lining, flow rate and conditions
Internal surface of the MAXbend after 24 months.

During this use period of the same original MAXbend, flow rate was increased by 22% by Plant Ops Management with other process conditions remaining unchanged.

Still in service after 39+ months (as at July 2015).