

Online monitoring technology for reciprocating plunger and diaphragm pumps

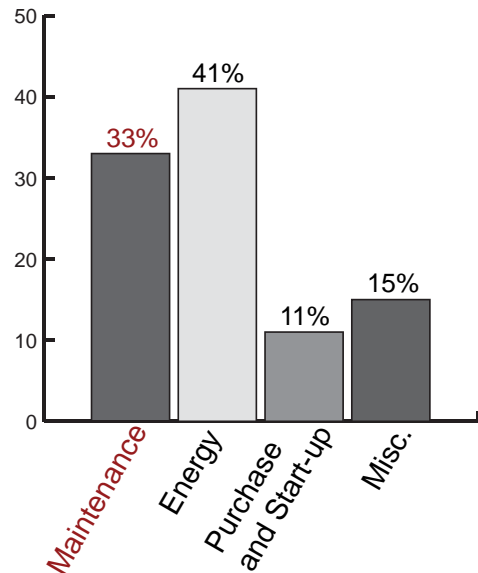
**PROGNOST<sup>®</sup>-*Pump***

# PROGNOST® online monitoring technology for reciprocating plunger and diaphragm pumps

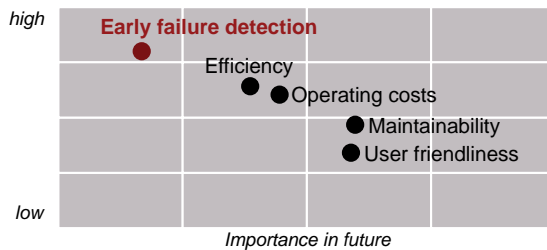
Long periods of increasing profit margins enjoyed by many business sectors in the chemical and process industry have come to a halt. Operators today are faced with the challenge of increasing plant efficiency by maximizing product output and minimizing production costs.

In order to determine a realistic figure for new equipment investments, operators calculate machinery costs not only based on the initial purchase price but upon lifecycle costs. This includes all costs of the asset within its estimated lifetime, e.g. 15 years. Besides the investment for the pump itself, its installation and start-up costs, maintenance efforts, component replacements and energy costs have to be added. **Typically, the lifecycle cost of pumps outweigh the initial purchase investment by a factor of 4 to 1.**

Although oscillating pumps comprise a relatively small share in the overall pump market, their niche application as powerful high pressure pumps or exact dosage pumps make them the dominating asset in many critical process chains. **In this context, production losses due to pump outages are a significant factor in the plant efficiency equation.**



Lifecycle costs of a standard 5kW pump in chemical process



(U. Klapp, monitoring and failure diagnosis of oscillating displacement pumps, Erlangen 2004)

## The most effective tool to optimize production efficiency is reliable early failure detection.

In 1998, the Germany based Machinery Manufacturers Association (VDMA) initiated a survey among pump operators, manufacturers and scientists and asked for their most critical development needs.

**The result was clear: Early failure detection was in strongest demand by the survey participants.**

## Asset reliability<sup>1</sup>

Operators of oscillating pumps expect a significant increase of asset reliability when installing an online monitoring system. Because oscillating pumps are critical assets in the production chain, reduction of unplanned outages directly eliminating non-recoverable production losses, avoided consequential damages

and optimized MTTR (mean time to repair) is key, especially efficient root cause analyses following emergency shutdowns.

PROGNOST®-Pump provides the capabilities to positively influence all factors that define the asset's reliability.

Increase MTBF <sup>2</sup> Meantime between Failure	Avoidance of unscheduled shutdowns by detection of disadvantageous operating conditions <input checked="" type="checkbox"/>	Early detection of impending failures to avoid unscheduled shutdowns and costly damages <input checked="" type="checkbox"/>
Decrease MTTR <sup>3</sup> Meantime to Repair	Fast and reliable root cause analysis in case of shutdown <input checked="" type="checkbox"/>	Fast and efficient overhauls and repairs due to complete preparation <input checked="" type="checkbox"/> Avoidance of time-consuming and expensive repair of consequential damages <input checked="" type="checkbox"/>

<sup>1</sup> Reliability (number of failures): Gives information about the failure-free interval  
<sup>2</sup> MTBF (Mean Time Between Failure) The average time a component works without failure  
<sup>3</sup> MTTR (Mean Time to Repair) The average time a replacement or overhaul takes.

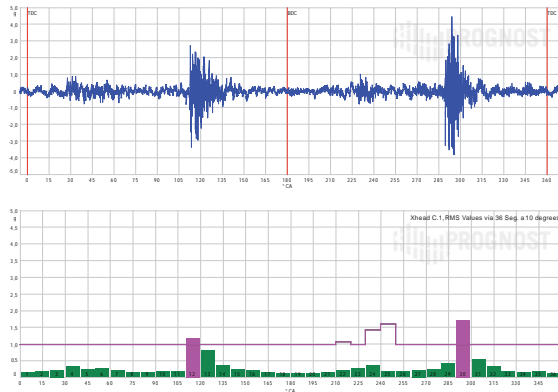
## General information

PROGNOST®-Pump is a reliable online monitoring system, optimized for process-critical reciprocating, plunger and diaphragm pumps (oscillating displacement pumps). It is based on PROGNOST®-NT and offers the optimum price/performance ratio for Safety Protection and Early Failure Detection. For diaphragm pumps the powerful Efficiency Optimization module is also applicable.

PROGNOST®-Pump monitors the motion works, valves and the pressures within suction and discharge manifolds. It provides full Safety Protection and Early Failure Detection for oscillating pumps. Equipped with a vibration sensor on the pump housing and pressure probes in the suction/discharge manifolds, operators receive the following asset analyses:

## Safety Protection

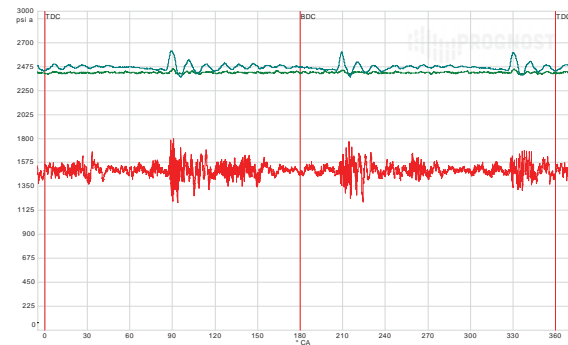
- Vibration monitoring (RMS) over 36 segments each 10° crank angle
- Peak-to-Peak pressure values in suction and discharge manifolds over 360° crank angle



Cylinder vibration over one revolution is divided into 36 segments. Each 10° crank angle segment is analyzed and thresholded independently.

## Early Failure Detection

- Average of pressure in suction and discharge manifolds over 360° crank angle
- Vibration monitoring: absolute maximum over 36 segments each 10° crank angle
- FFT analyses



Acceleration vibration signal showing discharge valve opening of a triplex pump. Dynamic pressure measured in the discharge manifold shows pressure peaks corresponding to valve opening peaks



## PROGNOST®-Pump capabilities:

This proven online monitoring technology will improve operational reliability and reduce repair costs by allowing pinpoint maintenance.

PROGNOST®-Pump detects those impending failures that cause ...

- ... unscheduled shutdowns  
(e.g. **valve failures**)
- ... costly consequential damages  
(e.g. **motion work failures**)
- ... reduction of asset efficiency  
(e.g. **pressure losses**)

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