

# Application Note

## pH in Iron Slurry

**Industry:** Metal & Alloys (Steel)  
**Product:** pH Process Liquid Analyzers

### Introduction

During mining and processing, generation of fines and slime typically ~ 35 % and 10-25% of run-of-mines is a great concern to environment and loss of iron value. Iron ore fines and slime contain ~ 58 % Fe, high amount of alumina (> 8 %) and silica (~ 8 %). Statistics showed that the increase in 1% Fe in the concentrate productivity of the hot metal increases by 2 % and thereby coke and limestone requirements reduced by 1.8 % and 0.9 %, respectively. Considering the feed quality for the blast-furnace and the need to conserve the non-renewable resource, beneficiation of iron ore fines and slime is essential so that the  $Al_2O_3/Fe$  and  $Al_2O_3/SiO_2$  ratios are brought down below 0.05 and 1, respectively in the concentrate.

The simple plain water washing alone cannot change  $Al_2O_3/Fe$  and  $Al_2O_3/SiO_2$  ratios in the concentrate much from the feed. An alternative approach is to use techno economically cheap and eco-friendly surface-active agent(s) for beneficiation of iron ore fines and slime. In this context several synthetic chemicals are used viz., charged and uncharged polyacrylamide, starch humate and inorganic or organic additives or both. The main objective in these studies was to recover iron value from iron ore fines. The surface-active agents, either simple or complex, adsorb onto hematite surfaces resulting in flocculation of hematite particles and dispersion of gangue minerals rich in alumina.



Figure 1.

**Fig.** A typical snapshot showing (a) dispersed phase (b) flocculation/settling of suspended particles in 1 % DP of slime slurry in the presence of natural hard water and (c) stable dispersed phase of 25 % iron ore fines using water from (b) and 0.05 % humate.

Dewatering and/or recovery of water from waste water/slurry is also an essential step in the iron ore washing. In an iron ore washing plant huge amount of water is required further there is loss of water and fresh water typically ~15 % is added to maintain the total amount of water in the washing circuit. Different kinds of flocculants are used for this purpose. Moreover, natural hard-water can be used as an alternative because it contains different ions, which are effective flocculating agents.

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### Why pH is required?

The “specific ion effects” in the metal oxide suspension is important to understand the behaviour of ion to modulate the surface charge of the oxide particles and subsequent change of pH of the suspension. It has already been seen that the pH of ferric hydroxide suspension with aging varies differently depending upon its initial value.

### Efficacy of surface-active agent

The efficacy of the surface-active agents in removing the gangue minerals in the suspension of iron ore fines is observed at higher scale (500 g iron of fines/2000 mL water) at pH 8. The slurry shall be mixed properly in the container with a stirrer for about 15-20 minutes at a fixed additive dose and pH8.

## Typical process details

- Plant: Beneficiation plant, pellet plant
- Application: Iron ore slurry is pumped from beneficiation plant to pellet plant. pH measurement at pellet plant required.
- Service: Iron slurry
- Process composition: Iron dust 30%, Balance water
- Temperature: 40 degC

## Typical problems

- Frequent cleaning required and sensor should be robust.

## Remedies

- Use of specialized cleaning

## Product Recommendations

### Measurement System

#### Process Liquid Analyzer:

- 2-wire FLEXA pH/ORP Analyzer



#### Features

Dual sensor measurement on 2-wire type analyser  
Indication of sensor wellness

- 4-wire PH450G pH/ORP Analyzer



#### Features

Easy touchscreen operation  
Trending display up to 2 weeks  
Advanced Process Temperature Compensation

### Sensor Selection:

#### Option #1:

#### Sensor:

SC25V sensor series from Yokogawa is the perfect sensor for this application. High temperature sensor SC25 because of its design can serve purpose.



#### Features SC25V

External titanium Liquid Earth  
Pt1000 integration in pH compartment giving highly accurate temperature compensation  
CIP and Steam cleaning possible  
Large internal KCl volume giving the sensor a longer life time  
• SC25V-ALP25 for the harsh applications and high temperatures

#### Cable:

WU10-V-S series

#### Fitting:

- RF20H PH RETRACTABLE HOLDER

The retractable holder RF20H is made for installation of Ø12mm sensors on tanks or pipelines where the sensor has to be removed without interruptions or shutdowns and in the hash applications where frequent cleaning is of vital importance for a good pH measurement.

The retractable fittings installed with a suitable process connection to a containers or pipe. In order to adapt to the various process connections, the retractable fitting RF20H is made of high-grade metal or plastic. In addition one can choose between different process- and flush port connectors, sealing materials and sensors

- RF20M PNEUMATIC CONTROL UNIT



The pneumatic control RF20M is a pneumatic control unit for retractable fittings such as the RF20H. With this control unit it is possible to drive the retractable fitting into the positions “maintenance” and into the position “Service” and again back. The reached position is acknowledged over pneumatic feedback and show on the cabinet by lamp indicators. With the use of pushbuttons, Pneumatic valves can be opened and close for the control of rinsing solutions and draining. When the pushbutton is activated, pneumatic signals are produced, which opens the rinsing- and drain valve.

**Features**

- Robust design
- “plug and play” installation and connections
- Up to 2 different cleaning solutions can be controlled
- Detection of holder position
- Driven by air at 6 bar
- No electrical installation necessary

**Note:** This is a non-standard product. Please contact your local Yokogawa Process Liquid Analyzer Department for the availability.

**Option #2:**

(Example of codification mentioned)

*Sensor:*

PH8EFP-05-TN-TT2-N-G\*A/PF/HA/TF



PH8EFP standard Ryton pH sensor is solid electrolyte pH sensor. With the body made of Ryton, a strong engineering plastic, which is comparable to Teflon in terms of corrosion resistance and heat resistance, it allows for a wide range of applications. The integrated-sensor design simplifies calibration with standard solutions and maintenance.

*Holder:*

PH8HS3-PP-03-C-YP\*C/SC

The EXA AUTO CLEAN chemical cleaning pH measuring system incorporates an intelligent pH converter that provides advanced sensor diagnostic functions. This measuring system features automatic chemical cleaning of the pH sensor as well as highly-

reliable pH measurement; thus, it successfully meets an increasing need for accurate, reliable, and maintenance-free measuring systems.

pH level in rivers, and so on. Generally, pH sensors are subject to aging due to contamination and deterioration, and require periodic cleaning to maintain their performance. The EXA AUTO CLEAN chemical cleaning pH measuring system solves this problem, while facilitating labour savings and eliminating dangerous operations at the job site.

Functions: Moves the pH sensor up or down using an air cylinder, and provides facilities for chemical cleaning.



**Tangible benefit**

Save down time in cleaning, repeated calibration, improve end product quality.

**Note:** For additional information on this application contact the local Yokogawa Process Liquid Analyzer Department