

**CASE STUDY**

# Real-Time Concentration Monitoring in Metal Cutting Fluid Management

Inline measurement of concentrate, pH, corrosion inhibitor, and pH buffer for product integrity and process optimisation



In metal cutting and machining operations, cutting fluid concentration is one of the most critical process parameters. Too low and tools wear prematurely; too high and costs escalate unnecessarily. Until now, monitoring has relied on manual BRIX refractometer readings and periodic lab sampling — neither of which can track real-time process changes.

Spectrolytic **FluidInspectIR®** delivers inline, continuous measurement of total concentrate, pH, corrosion inhibitor package, and pH buffer — providing the real-time data needed for genuine product integrity assurance and automated fluid management.

**R<sup>2</sup> = 0.99**

Concentrate measurement  
accuracy (vs. BRIX)

**4-Parameter**

Concentrate · pH · Corrosion  
Inhibitor · pH Buffer

**Automated**

Key enabler for Metal  
Cutting Fluid management

## The Challenge

Metal cutting fluid concentration must remain within tight tolerances throughout the machining process. Concentration that drifts too low compromises lubrication and corrosion protection; too high increases costs and risks dermatitis for operators. Additives such as corrosion inhibitor package and pH buffer are equally critical and equally difficult to monitor without laboratory analysis.

The fundamental challenge is that traditional methods — BRIX refractometry and titration — are manual, intermittent, and cannot track the real-time fluctuations that occur as fluid is consumed, diluted, or degraded during production.

- No real-time visibility into cutting fluid concentration between manual checks
- BRIX measurements do not distinguish between total concentrate and individual additive components
- Corrosion inhibitor and pH buffer depletion cannot be detected without laboratory analysis
- Fluid management decisions made retrospectively, leading to reactive rather than preventive maintenance
- No automated feedback loop to trigger top-up or replacement when parameters drift out of spec

## The Solution

A **Spectrolytic FluidInspectIR®** system was installed inline on the metal cutting fluid circuit, providing continuous, real-time measurement of four key parameters simultaneously: total concentrate, pH, corrosion inhibitor package, and pH buffer.

IR spectroscopy data showed **excellent correlation with BRIX measurements** — and went far beyond them, capturing additive-level detail that refractometry fundamentally cannot provide. Predictive models for each parameter were built with  $R^2$  values above 0.98, confirming the system's suitability for production-grade inline monitoring.

## Implementation

- FluidInspectIR® installed inline on the metal cutting fluid circulation system — no sample extraction required
- Calibration models developed for Total Concentrate ( $R^2 = 0.99464$ , RMSE = 0.342), Corrosion Inhibitor Package ( $R^2 = 0.98179$ , RMSE = 0.528), and pH Buffer ( $R^2 = 0.99355$ , RMSE = 0.314)
- Continuous trending data captured across production shifts — enabling time-series analysis of fluid condition
- IR data validated against BRIX refractometer readings, confirming outstanding measurement accuracy
- Platform configured to output real-time alerts when any monitored parameter drifts outside defined control limits

## Results

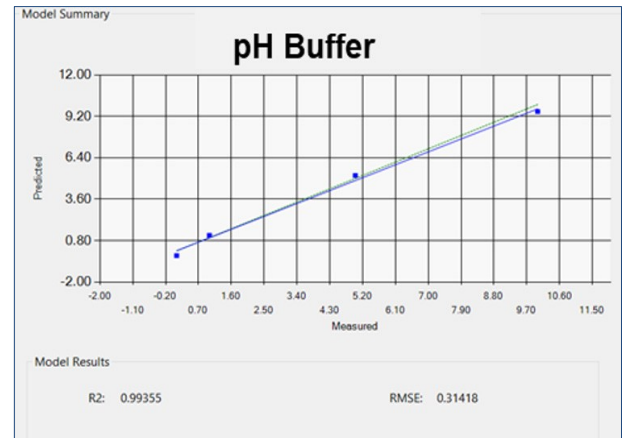
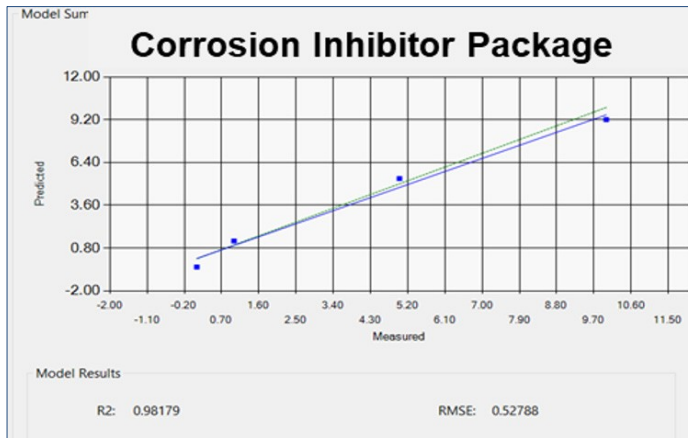
Deployment demonstrated the following:

- Total Concentrate measured inline with  $R^2 = 0.99464$  — matching laboratory-grade accuracy in real time
- IR data showed excellent correlation with BRIX — confirming readiness to replace manual refractometry
- Corrosion Inhibitor Package and pH Buffer both measured with  $R^2 > 0.98$  — parameters invisible to BRIX
- Continuous inline trending revealed concentration fluctuations between manual checks — previously undetected
- System confirmed as the key enabler for full automation of metal cutting fluid management

### USE CASE — METAL CUTTING FLUIDS: CONCENTRATE & ADDITIVE TRENDING



*Real-time Total Concentrate trending data captured by FluidInspectIR® across production shifts — revealing concentration fluctuations between manual checks that would otherwise go undetected.*



Left: Corrosion Inhibitor Package ( $R^2=0.98179$ ,  $RMSE=0.528$ ) Right: pH Buffer Package ( $R^2=0.99355$ ,  $RMSE=0.314$ )

## Operational Impact

- Continuous inline monitoring eliminates reliance on periodic manual BRIX checks
- Real-time data enables automated top-up and fluid management decisions — reducing operator intervention
- Early detection of additive depletion prevents quality escapes and tool wear incidents
- Corrosion inhibitor and pH buffer monitoring provides a level of insight impossible with refractometry alone
- Trending data provides traceability for quality management and process optimisation programmes
- Reduced laboratory testing costs through inline measurement of parameters previously requiring external analysis

## Key Insight

The outstanding correlation between FluidInspectIR® IR data and BRIX measurements ( $R^2 = 0.99$ ) confirms that mid-infrared spectroscopy is ready to replace manual refractometry as the primary measurement method for cutting fluid management. More importantly, it goes significantly further — measuring corrosion inhibitor and pH buffer concentrations that BRIX simply cannot detect, transforming fluid management from reactive to genuinely predictive.

## Financial Benefits

Reduced fluid costs + extended tool life + fewer quality escapes:

**Proven ROI**

*Comprising: cutting fluid savings through optimised dosing, reduced tool wear costs, and elimination of manual sampling labour*

## Conclusion

**Spectrolytic FluidInspectIR®** delivers production-grade, real-time measurement of metal cutting fluid concentration and additive chemistry — inline, continuously, and without manual intervention.

With measurement accuracy matching laboratory BRIX analysis and the ability to monitor **corrosion inhibitor and pH buffer packages that BRIX cannot detect**, FluidInspectIR® represents a step-change in cutting fluid management capability.

Organisations that deploy FluidInspectIR® today are positioned to automate their fluid management processes, reduce costs through optimised dosing, and eliminate the quality risks associated with undetected concentration drift.

Interested in understanding how this can be applied within your operations?

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