

PERFORMANCE SHEET

TIN PLATING - QUAKERTIN™ MSA TECHNOLOGY

BACKGROUND

The **QUAKERTIN™** MSA tin plating process represents the latest technology for applying tin to steel substrates for the packaging industry. Our approach provides customers with the lowest applied tin cost and the lowest environmental impact. Coupling Quaker's MSA technology with the industry's standard for service offers our customers with the finest tinplate available in today's market.

OUR FLAGSHIP PRODUCT

QUAKERTIN™ process is a pure tin process formulated for use on high speed electro-tin line applications.

BENEFITS

- » Very low foam characteristics
- » Simple process control and solution analysis
- » Wide current density window with consistent appearance across the strip width
- » Uniform tin grain structure; suitable in both matte and melted applications
- » Excellent solderability
- » Additives are analyzable and can be auto-dosed on an ampere/hour basis

BENEFITS OF MSA VS. PSA ELECTROLYTE

By nature, PSA (Phenol Sulfonic Acid) electrolytes pull tin toward the edges of the strip during the plating process, resulting in uneven plating and over-consumption of tin in order to stay in spec at the center. MSA (Methane Sulfonic Acid) is designed to give you at-spec plating across the entire strip, creating a more precise plate that consumes less tin.

COST FACTORS	PSA ELECTROLYTE	MSA ELECTROLYTE
Tin Solution Requirements	30 g/l	20 g/l (33% lower)
Tin Sludge Loss	Current Loss	Reduced Loss
Tin Overcoat Loss	Current Loss	Reduced Loss
Solution Loss	Current Loss	33% Less Sn Loss
Sludge Disposal	Cost due to Phenol	Highest Price for Sn Value
Environmental Costs (Waste water treatment)	Current Loss	Significant Reduction
Chemical Oxygen Demand	Current COD	Forty Times Lower (40X)
Tin Generator Operating Cost (Oxygen & Power)	Current O ₂ and Power	33% Lower O ₂ and Power
Plating Energy Cost	Current Volts	1.5 to 2.0 Volts Less
Employee Safety and Health	Mutagenic	REACH Compliant

ADVANCED MSA TECHNOLOGY

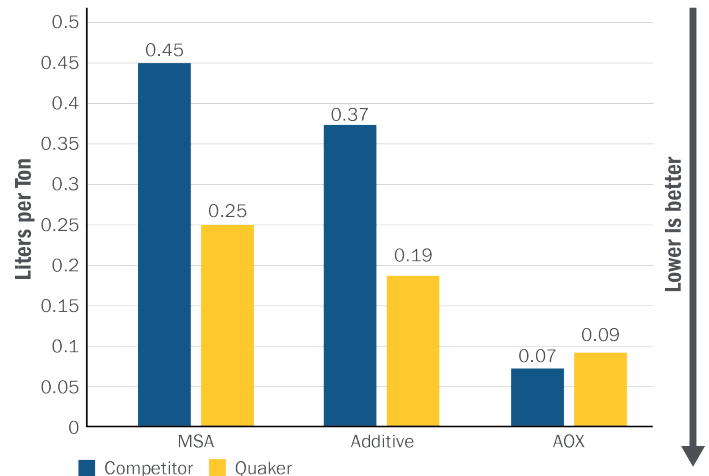
COMPETITIVE COMPARISON

FACTORS	QUAKER	COMPETITOR
Cost Per Ton	Lower (Less Sludge and Flux Recovery)	Higher Sn Losses
Additive Fe Tolerance	0 - 35 gm/l	< 20gm/l
Flux Sn Losses	Closed Loop = "0"	Sn Losses
Sludge Reduction*	1.5 tons/month	12 tons/month
Flux Fully Compatible with MSA Electrolyte	No Sn Loss, Cost Savings vs Competitor	Sn Losses -\$3,840/month
Flux Concentration	5 - 15 ml/l	5 - 25 ml/l
Effect of Additive Cloud Point	None	Limited CD Range and Staining
Temperature Window	24 - 55°C	24 - 35°C

*Customer Supplied data 2015

COST SAVINGS ACHIEVED WITH LOWER CHEMICAL CONSUMPTION

MSA ELECTROLYTE SAVINGS WITH QUAKER CHEMICAL'S MSA



- » Quaker Chemical's MSA process provides a significant reduction in chemical component consumption for our customers
- » The Customer estimates a significant monthly savings of its Total Cost of Ownership versus the competitor's MSA process

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REFERENCE LIST

COMPANY	COUNTRY	LINES	CONVERSION	ANODE	ELECTROLYTE
Sparrows Point	USA	1*	2006	Horizontal	DOW
USS Midwest	USA	1	2009	Horizontal	DOW
Ohio Coatings Co.	USA	1	2010	Soluble (V)	DOW
USSPOSCO JV	USA	2	2013 - 2014	Soluble (V)	PSA
USS Gary	USA	2	2014 - 2015	Soluble (V)	PSA
Zhongshan Zhongyue	China	3	2013 - 2016	Soluble (V)	PSA
ZYPOSCO JV	China	1	2014	Insoluble (V)	PSA
Dongbu Dangjin	S Korea	1	2015	Insoluble (V)	DOW to QC
Youfu Tinplate	China	1	2016	Soluble (V)	New Line
Shagang Steel	China	1	2016	Soluble	DOW
AM Dofasco	Canada	1	2017	Soluble (V)	PSA
AM South Africa	Africa	1	2016	Horizontal	Halogen
AHMSA	Mexico	1	2017	Soluble	PSA
AN Trostre Works	Wales	1	2017	Soluble	DOW

*Sparrows Point exited the business effective 2012

TESTIMONIAL

“Anyone can deliver chemicals, but only leaders deliver service like Quaker”, commented a Production Manager who implemented a MSA plating operation and replaced a longstanding halogen process. In its tinning line, the plant was utilizing a halogen process, which is more expensive and lower performing, but capital requirements prevented an immediate MSA conversion. However, due to continuously high tin sludge losses and poor prime quality, the company eventually became interested in the quality improvements, operating advantages, and significant cost savings that an MSA process could bring along with the service that Quaker provided.

MSA TECHNOLOGY QUAKERTIN™ FLUX

