

# Oilfield solutions

Improving performance and sustainability



- ▶ Good Scale remover
- ▶ High solubility of hard water salts
- ▶ Building block for cross-linkers
- ▶ Low toxicity

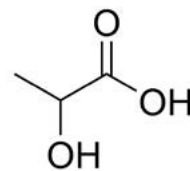
The oil industry constantly searches for products to improve performance and reduce processing costs. In addition, the pressure to use environmentally-benign products is growing. The cost of cleaning up and disposal of waste streams continuously increases. Corbion's unique biobased products provide a significant contribution to fulfilling these needs. Corbion Purac has been producing lactic acid and derivatives through white biotechnology for over 80 years. Our products have a biocontent of up to 100%. They can reduce your CO<sub>2</sub> footprint, are readily biodegradable and will not bioaccumulate. The functionalities of our product range include descaling, pH adjustment and building blocks to synthesize customized polymers or crosslinkers. Alongside our standard products, we can develop new lactic acid derivatives with properties tailored to the specific needs of your application.

## Product Range

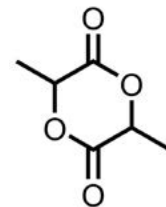
- ▶ PURAC® Lactic acid
- ▶ PURALACT® Lactide
- ▶ PURASOLV® EL Ethyl lactate
- ▶ PURASOLV® BL n-Butyl lactate
- ▶ PURASOLV® EHL 2-Ethylhexyl lactate

## Applications

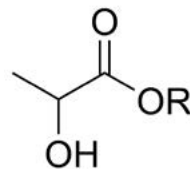
Lactic acid and derivatives are used in several applications, such as descaling, cleaning cuttings, fracturing and desalination. Lactic acid is also used to produce metal lactates, when applied as active cross-linkers in drilling- and fracking operations.



PURAC® Lactic acid



PURALACT® Lactide



PURASOLV® Lactate

R = C<sub>2</sub>H<sub>5</sub> (ethyl)

R = C<sub>4</sub>H<sub>9</sub> (butyl)

R = C<sub>8</sub>H<sub>17</sub> (2-ethylhexyl)

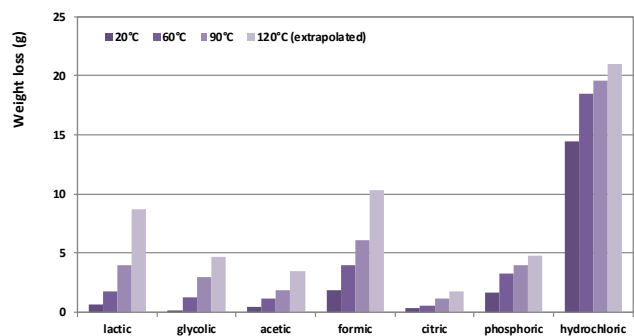


Figure 1. CaCO<sub>3</sub> Scale removal efficacy

### Descaling

Lactic acid is an effective scale remover, while retaining its low corrosive properties. Figure 1 shows the effectiveness of lactic acid as a scale remover at different temperatures, measured by weight-loss of a calcium carbonate (CaCO<sub>3</sub>) block. At 120°C/248°F the performance of lactic acid exceeds glycolic, acetic, phosphoric and citric acid. In addition, salts from lactic acid are highly soluble in water (see Table 1).

### Corrosivity

Lactic acid is very mild on constructional metallic materials, compared to other acids, as shown in Figure 2. In addition, the volatility of lactic acid is very low, resulting in reduced impact of corrosion due to acidic vapors

### Regulatory & Safety Aspects

Lactic acid is safe, readily biodegradable and easy to handle. It is readily biodegradable and will not impact the Biological Oxygen Demand (BOD) or Chemical Oxygen Demand (COD) of formulated products. Transport of lactic acid can also provide benefits, as it does not have a transport classification.

Temperature (°C/°F)	Solubility Calcium lactate (g/100 g water)
5 / 41	5,7
20 / 68	8,1
60 / 140	37,9
80 / 176	136,6

Table 1. Solubility of hard water salt

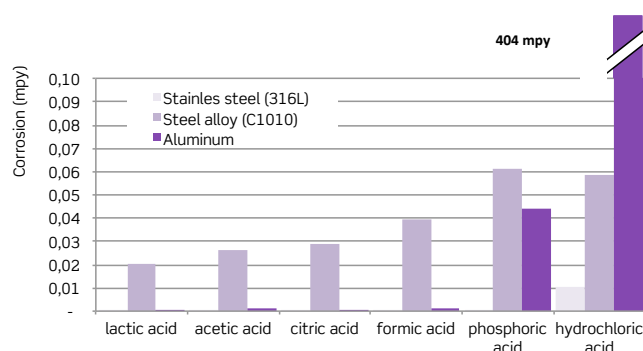


Figure 2. Corrosivity (mpy)

		Lactic acid	Acetic acid	Citric acid	Formic acid	Glycolic acid	Hydrochloric acid	Phosphoric acid
<b>Regulatory</b>								
CAS no.		79-33-4	64-19-7	77-92-9	64-18-6	79-14-1	7647-01-0	7664-38-2
EC no.		201-196-2	200-580-7	201-069-1	200-579-1	201-180-5	231-595-7	231-633-2
TSCA registration		yes	yes	yes	yes	yes	yes	yes
Transport classification		none	8	none	8	8	8	8
<b>Toxicity</b>								
LD50/oral/rat	mg/kg	3534	3310	3000	1100	1938	900	EP
LD50/dermal/rat	mg/kg	>2000	1060	n.a.	n.a.	n.a.	1449	USP
<b>Toxicity</b>								
BOD <sub>5</sub>	mgO <sub>2</sub> /mg	0,45	0,34 - 0,88	0,42	0,086	n.a.	n.a.	n.a.
COD	mgO <sub>2</sub> /mg	0,9	1,03	0,728	0,348	n.a.	n.a.	n.a.
EC50/Algae	mg/l	2800	n.a.	640	n.a.	164	n.a.	n.a.
EC50/48h/Daphnia	mg/l	130	>100	100	34	141	n.a.	n.a.
ILC50/48h/Fish*	mg/l	130	75	760	5000	93	3,6	3,5



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For chemical industry, Corbion offers Lactic Acid, Lactide and Lactic Acid derivatives like lactate esters, mineral and metal salts. Corbion's products are highly cost-effective, safe for human beings and readily biodegradable, enabling manufacturers to develop environmentally safer and more sustainable formulations and processes. Our products are successfully used as solvents, intermediates, process aids and polymer additives within diverse markets such as Agrochemicals, Plating, Textile, Oilfields and Packaging.