

# Opportunity Guidelines for the Utilization of ECA Super Catholyte™ for Well Remediation, Stimulation and Improved Oil Recovery ( IOR)

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## ECA ( Electrochemical Activation) Technology Summary:

Introduction: ECA manufactured Catholyte and Super Catholyte are produced by electrochemical activation (ECA) of various clean salt solutions which provide an environmentally friendly and non-hazardous, high concentration ( 2000-3000 ppm) , alkaline solution ( NaOH-sodium hydroxide or KOH -potassium hydroxide) which when used either as a stand-alone or synergistic mixture with other appropriate additives such as infusions with Nanogas Nitrogen Spheres (nanobubbles) , and/or green or environmentally friendly surface active agents to provide, and enhance the properties of degreasing, surface energy, diffusion driven disjoining pressure and fragmentation to maximize oil recovery from oil and gas reservoirs. Treatment volumes and protocols are designed as unique tailored proposals based on each specific well's intervention challenge ( wellbore and/or formation damage type, declining production, etc. There are no temperature limitations or environmental handling issues associated with this product. One very significant difference is that the electrolyzed alkaline water will have a negative 900 mv ORP and chemically mixed NaOH will have a positive ORP. It is known that a negative ORP helps the catholyte attract and retain soils, fine particulates and oils and allow their transport through and out of porous media. The surface tension is also significantly lower with ECA produced catholyte than chemically blended caustic ( NaOH). Finally the handling safety and skin contact effects at equivalent ph ( 11-12) are much more benign with ECA produced catholyte than ordinary caustic soda or NaOH ( sodium hydroxide) solutions.

1. **Opportunity** :Damage removal with simultaneous Production recovery or enhancement: Catholyte or Super-Catholyte (1500-3000 ppm) can be used as a new well intervention treatment in a variety of ways.

**Applications:** Pump or introduce between 25 and 150 gallons of Super Catholyte (with or without Nanogas nitrogen spheres) per net foot of pay zone to remove suspected wellbore damage components from the wellbore and near wellbore formation. It can be applied after an acid breakdown and flowback, or as an intermediate treatment in order to clean up residual residue, altered wetting effects, or precipitated reaction products ( or combinations thereof). Volumes between 1000 and 20,000

gallons can be designed appropriately for such applications and pumped with standard stimulation pumps or as simply as kill truck pumping units.

**Effectiveness:** Expectations for these type treatments include 30-600 % production recovery from damaged wells ; clean up of potentially damaging additives or additive residues left over from previous intervention or drilling operations, It is difficult to quantify these results since it is almost impossible to know the exact extent of suspected damage. Often many wells have relatively shallow damage radii that can be improved with as little as 25 gallons Catholyte -Free® per foot of payzone or net pay if known.

2. **Opportunity and application :** Catholyte or Super-Catholyte may be added to nitrogen clean-out treatments to provide a non-foaming recovery aid using between 500 and 10,000 gallon solution and equivalent volumes of Nitrogen gas to prepare a well to be placed on line after it has been drilled. The catholyte may be used as part of the completion process to help clean the borehole and act as a near wellbore formation conditioner to provide unique surface conditioning properties to help maximize initial production.

3. **Opportunity, Application:**

Catholyte or Super-Catholyte( 1500-3000 ppm) may be used to remediate existing older or underperforming wells where production has dropped to lower than expected rates. Volumes of 1000 -10,000 gallons are usually selected based on interval thickness, bottom hole temperature, and spacing within a field or unit and pay thickness. Once designed for these and sometimes more specific parameters, the treatment is pumped down tubing and over displaced into the formation by one tubing volume of a formation compatible fluid or additional catholyte so as to effect wellbore clean-up as well .The fluids may be heated to provide greater oil recovery efficiency ( with lower gravity crudes) and compatibility with the reservoir.

**Effectiveness:** This type of remediation may provide significant ( 200-600 %) production improvement for longer periods of time ( approximately 120days -1 year)

4. **Opportunity and Application:** Super catholyte may also be used to help mitigate bacteria sourced H<sub>2</sub>S (concentrations between 100 and 10,000 ppm via neutralization and then followed with anolyte (HOCl) to further convert and mitigate excess H<sub>2</sub>S so as to eliminate H<sub>2</sub>S or maintain reduced levels of H<sub>2</sub>S residual in produced fluids thereby reducing the level of

corrosiveness in order to help eliminate or postpone rod parting or tubular goods and pump corrosion effects. H<sub>2</sub>S sourced from Iron sulfide reacting with hydrochloric acid treatments may be mitigated with continuous batch treatments or the use of bubble tower containing the Super Catholyte adjacent with treatment towers using Hydrolyte™ anolyte as a sequential system which is renewed with new ECA fluids on a daily or weekly basis depending on the severity of the H<sub>2</sub>S problem( concentration) and production rate.

**Effectiveness:**H<sub>2</sub>S concentrations may be reduced up to 100 % for 24 hrs to seven days depending on production rates and reservoir conditions.

- 5. Opportunity:** Super Catholyte(with or without Nanogas nitrogen spheres or nanobubbles) may be manufactured for dealing with water sensitive formations such as shale and clay bearing reservoir rock.

**Application:**The design volumes should be tailored to specific well conditions or needs but can generally be based on the same volume parameters as described in opportunity number 3 above. The Super Catholyte™ can be produced in a Potassium (K) format known as Potassium Hydroxide (KOH) which has clay protection as well as enhanced oil recovery as demonstrated by the work of Marathon Oil Company/ Dr.Bob Sydansk in his publications and Marathon's proven technology.

**Effectiveness:**Using ECA produced KOH allows a greater efficacy to be provided for improving oil recovery efficiency than regular chemical KOH, and the ECA Catholyte- KOH will help maintain sustained recovery using the added surface, mechanical, and interfacial properties.

- 6. Additional Opportunities, Applications and Comparable Effectiveness:**

The ECA sourced Super Catholyte™ products NaOH and KOH .can provide excellent substitutes for other non- ECA manufactured chemistries for use in tank cleaning, pipeline cleaning, waterflood performance enhancement and as a one -two punch with ECA anolyte which can kill and clean bacteria biofilm and other micro-organism based products adhering to surfaces. As an example, 1000 ppm Super Catholyte ( NaOH or KOH) is equivalent to 10,000 ppm of chemically sourced NaOH or KOH) making the ECA versions more cost effective, safer to use and more environmentally benign. The shelf life to provide maximum efficacy for Super-Catholyte is two -three months!