

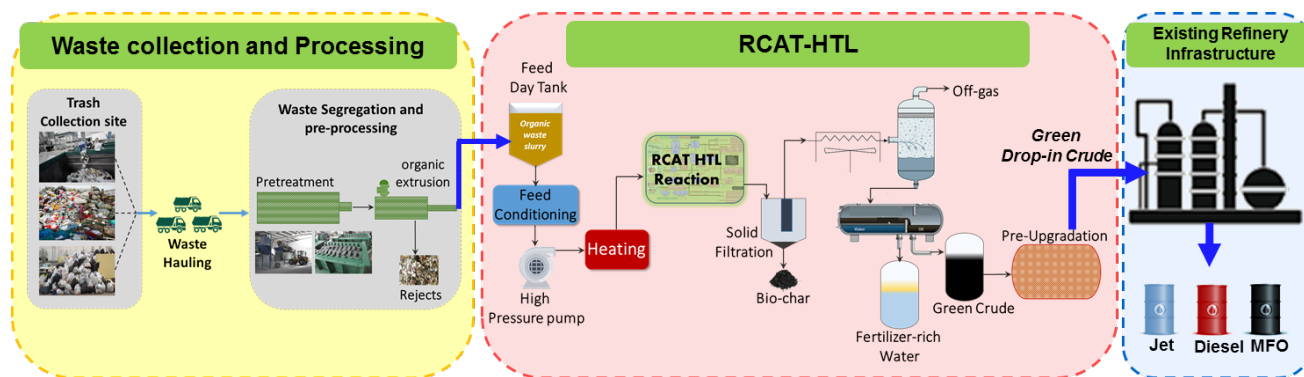
RCAT- HTL



RELIANCE CATALYTIC HYDROTHERMAL LIQUEFACTION (**RCAT-HTL**), a catalytic thermochemical process developed by Reliance Industries Ltd. (RIL), converts biomass, bio-waste, plastic waste, and any organic waste into energy-rich drop-in green liquid fuel. This environmentally sustainable process overcomes the limitations of the existing technologies and offers a green solution to the global problem of waste disposal. RIL's RCAT-HTL is feed-flexible – it can handle both dry as well as wet bio-waste, organic waste, mixed waste via standalone treatment or co-processing.

RIL has been leading efforts in development of clean, green and sustainable technologies for conversion of biomass to biofuel and bio-products. Research on hydrothermal liquefaction (HTL) process at RIL began as part of Algae to Oil (A2O) program in 2011, aimed to produce liquid fuel oil from algae. Most of the work world over on HTL till 2011, was limited to lab scale. RIL has set a landmark in biofuels industry by commissioning the world's first of its kind large HTL pilot plant at Biofuels site of Reliance. This plant was conceptualized by Reliance (as owner), Genifuel and PNNL (DOE lab), as part of National Alliance for Advanced Biofuels and Bioproducts (NAABB).

HTL essentially expedites the natural process of oil formation from biomass - instead of millions of years as taken by nature, HTL achieves the process in a few minutes. Reliance developed a patented RCAT-HTL technology which produces high quality renewable drop-in crude. RCAT-HTL uses catalyst and is an improvement over thermal HTL. RCAT-HTL offers immense flexibility on product profile to suit the market demand, by tuning the kinetics of the reaction. Drop-in green crude from RCAT-HTL can be processed in the existing refining infrastructure thereby avoiding the additional investment in new infrastructure. This unique advantage of RCAT-HTL makes the process economically and environmentally sustainable. RCAT-HTL has been recognized by many institutions including, prestigious Golden Peacock Eco-Innovation Award, Global Clean Energy Award and EEF Global Waste Management- Best Technology of the Year 2021.



Block flow scheme of RCAT- HTL process

RIL has accomplished significant milestones in developing hydrothermal liquefaction within a short span. RIL has designed, engineered, commissioned, and operated RCAT-HTL at various scales in batch (Lab scale) and continuous (Bench and Pilot scale) mode of operation. RIL’s RCAT HTL is at Technology Readiness Level (TRL) 7 and is all set for scale up from pilot scale to Pre-commercial capacity.

In a relatively short span of time, RIL has achieved breakthroughs in the areas of catalyst development, reaction kinetics modelling, design & engineering and RCAT-HTL operation at high temperature and pressure conditions. RIL has a dedicated team of scientists, engineers, and operations staff who developed invaluable knowledge base with 35+ patents and are working on advancing this technology towards commercialization.



Pilot plant of RCAT- HTL in operation at Jamnagar



RCAT-HTL recognized by Golden Peacock Eco-Innovation Award and Global Clean Energy award



Unique Features of RCAT- HTL

- ✓ **Feed Flexible:** By using RCAT-HTL any carbonaceous waste (wet and dry) can potentially be converted into drop-in green crude. It can generate value out of several wet organic biomass and bio-waste such as food waste, ETP sludge, Industrial sludge and agricultural crop residues.
- ✓ **No Drying:** Unique advantage of RCAT-HTL is that it can process feed with more than 80% water and eliminates high energy costs incurred due to feedstock drying, a mandatory pretreatment step for conventional waste treatment methods namely incineration, gasification, pyrolysis etc.
- ✓ **Water as Reaction medium:** At RCAT-HTL operating conditions (subcritical condition) water exhibits lower dielectric constant, weaker hydrogen bonds, and a higher isothermal compressibility than ambient liquid water. Water becomes highly reactive at operating conditions and biomass, plastics, and organics break down into a liquid renewable fuel.
- ✓ **Drop-in green crude** from RCAT-HTL can be processed in existing refinery infrastructure. This avoids additional capex for refining, transport, and distribution.
- ✓ **Substantial reduction in Green House Gas (GHG) emissions:** Offsetting fossil crude with RCAT-HTL drop-in green crude can achieve up to 85% reduction in GHG emissions.
- ✓ **IP Portfolio:** RIL placed 35+ patents on RCAT-HTL process & catalysts and also developed AI based Kinetic models and predictive simulation capabilities validated with in-house experimental data. Advanced Kinetic models developed at RIL provide comprehensive understanding of product mix with varying feed composition and process parameters.
- ✓ **High Carbon and Energy Recovery:** With RCAT-HTL, carbon recovery of more than 75% and feed energy recovery above 85% can be achieved. Reliance's proprietary 3rd Gen catalyst gives higher drop-in green crude yield and carbon recovery compared to other technologies.
- ✓ **Tunable Kinetics:** By changing kinetics of RCAT-HTL process, a product mix of biofuel and bio-products can be achievable as per market demand.



Aquastar Consulting and Engineering is an authorized representative of the RCAT-HTL technology. For more information contact us at www.aquastarengg.com

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