

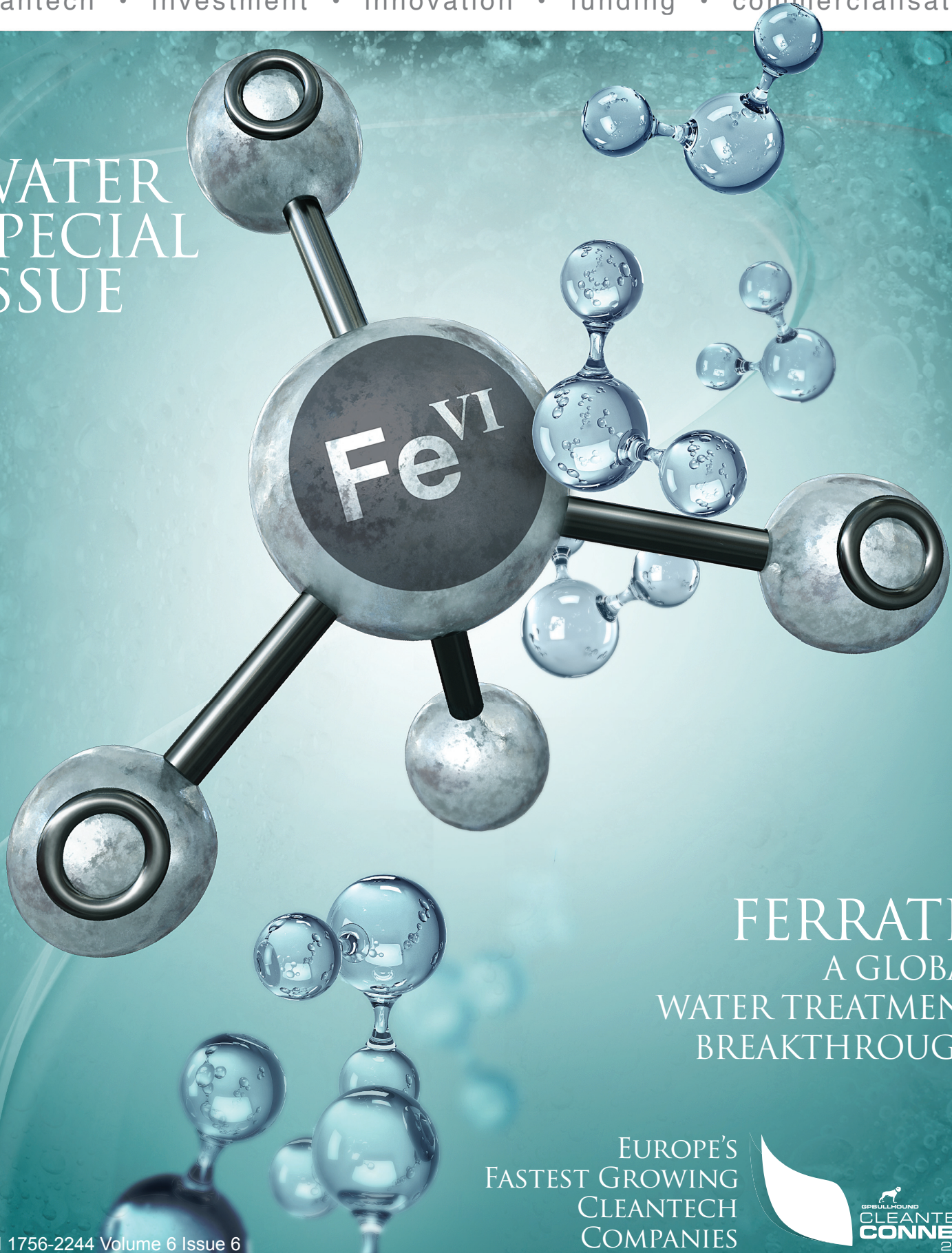
Cleantech



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WATER
SPECIAL
ISSUE



FERRATE:
A GLOBAL
WATER TREATMENT
BREAKTHROUGH

EUROPE'S
FASTEST GROWING
CLEANTECH
COMPANIES



Ferrate



A Global Water Treatment Breakthrough

Ferrate Treatment Technologies, LLC (FTT), based in Orlando, Florida, has invented a water treatment solution that combines all the best properties of existing water treatment chemistries. The FTT technology harnesses the cheap, industrial disinfection efficiency of chlorine, the environmentally friendly attributes of UV (no disinfection by-products), the oxidation power of ozone (but even more powerful), and the contaminant removal capabilities of a coagulant (clarified water) – almost too good to be true!

Like Google, privately-held IP development company FTT was named a Technology Pioneer by the World Economic Forum in 2011. FTT has invented a low cost manufacturing method to produce one of the most powerful, multi-use, yet environmentally friendly water treatment chemistries known. The technology is based on the low cost production of a supercharged iron molecule known as ferrate, (iron 6+), or (FeO_4^{2-}). The efficacy of ferrate chemistry and treatment applications for drinking water, wastewater and industrial effluents has been well documented, with over 450 peer-

reviewed, scientific studies published worldwide.

“The company’s on-site ferrate manufacturing methods and treatment techniques have the potential to significantly improve current water treatment methods,” says FTT CEO and Founder, Luke J. Daly. “Compared to conventional water treatment alternatives, ferrate offers unique treatment benefits, delivers multiple treatments from a single dose, creates no disinfection by-products, and solves difficult treatment challenges that competitors can’t address.”

Disruptive Technology

FTT’s on-site manufacturing method, treatment chemistry and patents are unique to the water industry in a combination that no competitor can reverse engineer or offer. FTT’s products represent the first truly fundamental breakthrough in water treatment in decades. Water expert Dr David Lloyd argues that “the last truly disruptive technology in the water sector was membranes and membrane bioreactors. Twenty years on, having changed

the treatment game, they are becoming commodity items.”

All water treatment boils down to water chemistry. Ferrate treatment is exceptional in that no other water treatment chemistry acts as a powerful oxidant, disinfectant and coagulant all delivered by a single dose. It reduces the number of process steps and cost of capital equipment required to complete a treatment train. Treatment chemistries are measured in volts as a reduction-oxidation potential and ferrate is more powerful than ozone, peroxide or chlorine. Only hydroxyl radicals have a higher redox potential and, because they are so short-lived, their practical application is very limited.

Ferrate, a naturally green chemistry produced from the same form of iron found in our bodies and all living things, is extremely powerful, but its treatment by-product is benign. As ferrate (iron 6+) grabs electrons to perform treatment, it falls back down to an iron hydroxide (iron 3+), the same form of iron found in a handful of dirt, making it ideal for environmental applications.

Water Treatment Chemistries

	Chlorine	Hydrogen Peroxide	Ozone	Ferrate
Oxygen atoms	None	2	3	4
Redox potential	1.39	1.78	2.08	2.20
Coagulant	No	No	No	Yes

Ferrate is a powerful oxidant with the ability to treat many contaminants where other water treatments are ineffective.



Ferrator Model Fe300 - Treats up to 90 MGD or 340,000 m³ of water per day



Hoisting an Fe70 Ferrator for New Orleans



Farmland Agricultural Run-off



Before and After Ferrate Treatment



FTT Founder & CEO Luke Daly

The Ferrator®

Ferrate chemistry has been known about for decades, but previous attempts to unlock its properties were based on manufacturing methods which produced a dried, hermetically sealed product that was too expensive to deliver in industrial quantities. FTT has unlocked ferrate's vast commercial potential by patenting an on-site synthesis method that reduces the number of synthesis steps from 23 to just five. By eliminating the storage, handling and transportation overheads required for a pre-packaged product, FTT has slashed traditional ferrate deployment costs. As Daly comments:

"While Dominos® didn't invent pizza, it revolutionised the pizza delivery industry. FTT didn't invent ferrate, but its compact on-site generator – the Ferrator – can deliver bulk quantities of ferrate for broad industrial use for the very first time."

There is no economical ferrate manufacturing competitor to FTT. Battelle Memorial Institute, one of the largest research organisations in the world, has advertised a **dried**, hermetically sealed ferrate product for **\$2 per gram**. At this price, Battelle's dry ferrate product, which is synthesised by a costly traditional method, is over 300 times more expensive for the same active ingredient than **liquid** ferrate produced by FTT's patented method. Furthermore, Battelle's manufactured price does not include delivery costs to the customer, while FTT's Ferrator manufactures ferrate on-site, ready for immediate use.

A two year, \$150,000 technology comparison and feasibility study backed by the Louisiana Department of Natural Resources found ferrate technology delivered the lowest lifecycle cost over chlorine, ozone and ultraviolet (UV) alternatives. Ferrate was further shown to treat municipal wastewater to the highest standard, allowing its re-use as a fresh water resource to restore the 28,000 acre bald cypress wetlands surrounding New Orleans. Research teams from two Louisiana universities confirmed that ferrate treatment

reduces the hormonal activity of endocrine disrupting compounds like estrogens by over 70%, while chlorine disinfection increased estrogenic activity by 180% in specific samples. In Florida, pilot testing showed that a ferrate treatment system would save \$4 million dollars in lifecycle costs versus a low pressure UV treatment system at a water reclamation plant. Pilot testing of phosphorus removal from agricultural storm water demonstrated >99% removal, at a fraction of the cost of other treatment technologies.

Seasoned Management

The company is led by its Chairman Colin Bailey, a chemical engineer and the former CEO of Calgon Carbon; Dr Thomas Waite, Chief Technology Officer, who is internationally recognised as the world's foremost expert on ferrate chemistry and its environmental applications; and CEO Luke Daly, a veteran entrepreneur and named inventor on FTT's patents who has raised \$10 million and personally contributed another \$7.5 million to fund the company's technology innovations.

Intellectual Property Assets

From the beginning the company's Founders invested heavily in building a solid IP foundation. FTT owns 100% of its patent portfolio, comprising 106 issued patents in 60 countries across six continents. These patents, and additional patents pending, protect FTT's broad-reaching utility and apparatus patent families and cover its synthesis methods, on-site reactors, water quality sensors and extensive applications knowledge. FTT's IP assets have been artfully and very broadly crafted to create a significant barrier-to-entry to any potential competitor. In February 2011, a lender hired the GTC Law Group, patent assessment experts, who independently valued FTT's IP portfolio as high as \$226 million.

The company continues new product development and in fact has recently devised a new method to synthesise ferrate that cuts product costs by an additional 25%; patent filings are pending.



Environmental Remediation – Mobile Soft Slide Ferrator System



The Fe50 Model Ferrator



Long Incubation, Poised for Explosive Growth

FTT has spent almost a decade inventing its chemistry, optimising yields, filing patents, scaling up prototypes, performing hundreds of lab scale treatability studies, obtaining federal certifications and designing, testing and fully automating its industrial quality Ferrators across multiple capacities. FTT has invested in the process of peer review and convincing sceptical consulting engineers and regulators. Because ferrate chemistry was so new and often misunderstood, it took the company 28 months to receive its initial NSF certification of its Ferrator for use in public drinking water systems. The company initially expected to receive approval to apply a dose of up to 10 mg/L. By the time NSF completed its toxicology testing, FTT was approved for an application dose rate of up to 50 mg/L, which is much higher than needed for water disinfection, based on the Ferrator's non-toxic residuals.

Three Year CAGR of 266%

FTT's sales started from a modest \$300,000 in 2010 and jumped to \$1.8 million the following year. In 2012, the company will have contracted \$4 million in sales, representing a compound annual growth rate of 266% over the last three years. More importantly, these sales are opening strategic opportunities to broad industrial

and environmental remediation markets like power generation, hydraulic fracturing of shale gas formations, the removal of metals and cyanide from mining wastes, municipal wastewater disinfection and re-use, wetlands restoration, phosphorus and nitrogen removal from agricultural and storm water runoffs, and for the first time ferrate treatment is being used to clean up a dying lake in central Florida.

FTT's global expansion strategy includes territorial franchises. Last year, FTT sold an exclusive countrywide licence to Mexico City-based Green Planet Aid (GPA) at a valuation that implies a potential global licensing market for FTT's technology at over \$300 million. Under the terms of this agreement, GPA, which treats wastewater with ferrate for re-use in agricultural, industrial and potable applications, will purchase another \$4 million of products and services from FTT by July 2013. A second licence was sold to energy company subsidiary, WesPac Water, for storm and dredge water treatment in five southeastern US states. In November 2012, WesPac took delivery of an Fe300, the largest mobile Ferrator treatment system ever manufactured; a 13-metre (44 feet) mobile trailer capable of treating up to 90 million gallons, or 340,000 m³, of water per day. WesPac is required to purchase an additional \$5 million of goods and services by the end of 2014 to maintain its exclusivity.

Major Markets: Mining, Oil & Gas, Power Generation

FTT recently teamed up with QCI, a Michigan-based pollution control specialist which is developing power plants throughout the Caribbean. QCI has placed orders for three Ferrator treatment systems for delivery in 2013 to clean heavy metals, ash and organics from flue-stack reject effluent. QCI is also developing ferrate applications for its wastewater, beverage and waste management clients.

Ferrate's unique treatment capabilities have also been demonstrated to treat mining effluents in Peru, Brazil and Australia. Multiple mining companies in Peru are in various stages of designing treatment trains and purchasing Ferrator systems for cyanide and metals removal. With a joint venture partner from the oil field services and logistics market, FTT has built a trailer-mounted Ferrator system to disinfect and remove toxic metals and organics from flow-back waters produced from hydraulic fracturing of shale gas formations. FTT has signed sales agreements with companies in South Africa, Korea, Eastern Europe and Jordan. To date, 20 US manufacturers' representative firms and 25 international, in-country representative firms have requested exclusive sales agreements for their home markets.

While significant pent-up demand exists for FTT's technologies, the company needs additional growth capital to expand its core infrastructure and staff to execute additional sales opportunities.

Global Platform

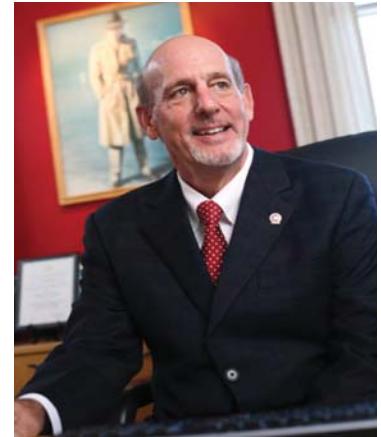
FTT has built the foundations for a global water technology platform. Today, most significant water treatment technologies are already owned and controlled by US and European multinationals. As one of the few free agents capable of becoming a significant competitor on the global stage in water treatment, FTT potentially represents a tempting acquisition target for new entrants or secondary players positioning to become number one. FTT's broad patents underpin its sole source supplier position, and the company's patent umbrella could be used to aggregate and increase the value of commodity technologies – such as separation, filtration, sensors and hardware items – that are integrated into a higher margin, total ferrate treatment 'solution'. In the right hands, above and beyond a purely financial play, FTT's technology offers an opportunity to quickly provide large quantities of safe drinking water for humanitarian, disaster relief and third-world initiatives.

Financing Opportunity

FTT's lean but effective staff currently handles all management, laboratory, engineering, manufacturing, sales, marketing and customer support functions. As enquiries, business development prospects and project opportunities continue to ramp-up each month, growth capital is the key constraint to driving adoption into the global marketplace and widely disseminating this technology for broad public use.

Patient investors are ideal candidates for this opportunity; any investor must appreciate the growth metrics of the business and be part of a three to five year plan to harvest a larger return. A strategic multinational could leverage FTT's technology within its existing sales infrastructure to broaden its applications base and accelerate growth. Alternatively, ferrate technology offers an opportunity for a private equity fund, family office enterprise or endowment to pursue a specific business or humanitarian goal. Daly states that, "FTT is seeking partners who share FTT's mission to apply this naturally green chemistry to purify and recycle water, improve human health by eliminating waterborne contaminants, and to clean up industrial toxins worldwide".

FTT's manufacturing breakthrough is the profitability engine that drives its vision. Stakeholders' profits and delivering a global impact will be the measure of its success.



Dr Thomas D. Waite, CTO

“FTT's ingenuity has made Ferrate available to the world, and it is a powerful addition to our existing assets in the battle against environmental degradation.”

Ferrate Applications

Water scarcity, water quality and treatment costs per unit are the primary drivers in the water treatment industry. Insufficient capital expenditures on water infrastructure, maintenance and treatment upgrades have led to increasing numbers of permit violations, fines, and pollution and water quality issues. Increasingly stringent treatment regulations, coupled with shrinking tax revenues and depleted municipal budgets, are driving regulators and plant

operators alike to seek more powerful, lower cost technologies like ferrate to enhance treatment and reduce operating and capital costs.

While all of the markets and applications listed below are differentiated by unique drivers, buying patterns and treatment requirements, ferrate's single dose, multiple treatment capabilities have demonstrated a competitive advantage in the following applications.

- 1) *Wastewater disinfection*
- 2) *Elimination of disinfection byproducts. (DBPs)*
- 3) *Wastewaters re-use. (ASR, wetlands restoration and industrial feed water)*
- 4) *Drinking water disinfection*
- 5) *Ballast water treatment*
- 6) *Hydraulic fracturing: flow-back water treatment (shale gas extraction)*
- 7) *Combined sewer overflows*
- 8) *Odour control (wastewater, sludge, air)*
- 9) *Colour removal (organic carbon)*
- 10) *Metals co-precipitation (As, Pb, Cr, Mn, Fe, Zn, radionuclides)*
- 11) *Aquatic species control (quagga and zebra mussels)*
- 12) *Phosphorus removal*
- 13) *COD and cyanide removal*
- 14) *Removal of micro-constituents and deactivation of endocrine disrupting compounds*