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Capacitance creates a watershed in purification

Water-softening and deionisation have been highly dynamic fields, especially over the last decade. Dutch company Voltea has managed its IP by embracing technological and market opportunities through two distinct phases of growth. The company was initially created as a spin-out from Unilever, with the IP rights being transferred to the newly created firm. In the second phase, when it had limited resources, Voltea used IP to build commercial co-operation and partnerships. Patents also allowed it to expand into new markets with new applications for the core technology.



Voltea's technology is designed to remove dissolved salts from a variety of water sources, from tap water and brackish groundwater to industrial process water.

Voltea offers products, software for data/system control, services for online data tracking and integrated solutions for softening and deionising water. Most water impurities are in the form of dissolved salt that can be removed by deionisation. The process, which can be done quickly and inexpensively using electro-deionisation, produces high-purity water.



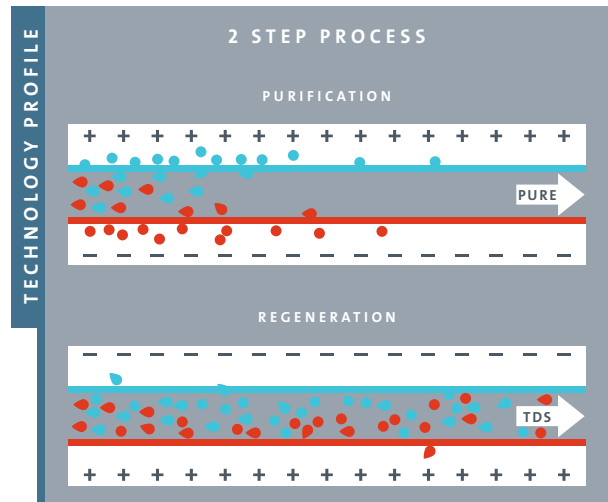
Voltea's CapDI water deionisation system with 24 modules. Each module produces approximately 0.5 m³ of clean, deionised water per hour. Like electricity smart metering, the CapDI system is controlled online, and no operator is required.

The idea behind the electrochemical deionisation of water initially emerged in 1960, with the first patent applications appearing at that time. Its commercial relevance became apparent in the late 1960s. From 1990 onwards, water capacitive deionisation gained in importance thanks to the development of new materials such as carbon nanotube electrodes. The term CDI (capacitive deionisation) was first introduced in 1996, and the phrase membrane CDI appeared around 2004. The pace of patenting accelerated through all these periods and is still growing.

Technical superiority with an environmental outlook

The key difference between Voltea's technology and standard CDI technologies is that the former uses capacitive carbon electrodes and ion exchange membranes to remove ions such as chloride and calcium from various water sources, including tap, well and brackish water. This increases the ion storage capacity of the carbon electrodes by up to 40% compared with standard capacitive non-membrane electrodes, which in turn results in improved efficiency and water recovery. Moreover, the use of ion exchange membranes reduces the sensitivity of the electrodes for scaling and fouling, which gives Voltea's CapDI module a longer life than competing solutions.

When applied to cooling towers, the main advantages of Voltea's technology are high water recovery, often above 80%, which means a more efficient use of the feed water and greater overall water savings in the cooling tower system, low energy use that allows for lower operational costs, temperature stability and a longer lifetime, which together make for a more environmentally sound process.



How does Voltea's technology work? Its membrane capacitive deionisation (CapDI) system is designed to remove ions from feed water by applying an electrical potential difference between two parallel electrodes covered with selective ion exchange membranes (purification step). The extracted ions are temporarily stored in the electrical double layers which are formed at the electrode surface. Once the electrode polarity is reversed the ions are released. The resulting concentrate stream then flushes the captured ions from the module (regeneration step).

“Patenting is a great way for businesses to protect innovative advances, but an effective IP strategy must balance commercial potential with the cost of reducing inventions to practical utility, and then ensuring enforcement.”



Bryan Brister
CEO, Voltea

Growth phase 1: R&D-driven

Voltea originated from an internal project at Unilever R&D in 2004. Back then, the objective was to develop an ion softener for washing machines and other consumer appliances. Unilever recognised the potential of its innovation and moved the project from Unilever R&D to Unilever VC (Venture Capital). In 2006, the project outputs formed the core technology for the spin-out, Voltea, which was founded by two inventors from Unilever, Bert van der Waal and Hank Reinhoudt. As part of the transaction, six patent applications were assigned to Voltea. In return, Unilever VC became the major shareholder. Since then, Unilever's role is mainly that of venture capital investor; it no longer has any function at R&D level.

Voltea, then still part of Unilever, began by focussing its R&D efforts on the development of a product based on a core technology (CapDI) in the field of water softening and deionisation. It made further developments to the membrane CDI technology invented by another company, Biosource Inc., giving it superior levels of performance (up to 90% water recovery), robustness, capacity and durability. Its technology then became unique compared with other CDI technologies available on the market at the time. From an IP perspective, the combination of Voltea's early patents with those of Biosource created a significant barrier to entry for competitors. Voltea was now the only company in the market with patents on the use of ion-exchange membranes in CDI devices.

As with many other high-tech start-ups, most of the value of Voltea was in its IP, especially during the first few years, when the company was not yet generating a profit. In this initial period, the business was characterised by negative cash flows, along with significant expenditure on building prototypes and assessing the technology's economic and commercial viability. Finding financing during this phase was difficult because few investors were willing to take on

the high-risk nature of the enterprise. However, the IP acted as a signal to future investors that Voltea might have a sustainable competitive advantage.

TAKEAWAY

IP PROTECTION

Applying an R&D-driven approach, first protect the key components of the core technology and get strong patents. There should be a good match between IP and the product, and this needs to be reviewed at each stage of product development.

Thanks to its intensive research and development activities, Voltea filed additional patents on its core membrane CDI technology for the purposes of establishing technology leadership and a reputation of excellence. Such strong IP protection gave investors confidence in its business potential. With the assistance of new investors Pentair and Rabobank, Voltea began to grow, both internally and externally. In 2008 it acquired Biosource Inc., the original developer of the membrane CDI technology. One of the main reasons for the acquisition was Biosource's patent on using ion exchange membranes in CDI systems (US6709560), which Voltea needed to gain a competitive edge over the standard CDI technology. The acquisition also ensured Voltea's freedom to operate.

Defensive IP

Voltea used its IP primarily to protect its membrane CDI technology applications and products in its core markets, such as the cooling tower business in Europe and point-of-entry/point-of-use (POE/POU) water softening in North America. POE systems are installed at the main water line where water first enters the home. POU systems are installed at a single water connection, typically under the counter of a kitchen or bathroom sink.

Patents were also used to protect and improve Voltea's market position. This was accomplished by watching competitors and enforcing patents against alleged infringers via legal action if required, and by seeking exclusivity, which secured market leadership. Voltea monitored the market, using feedback from consumers and resellers, reverse-engineering, claim chart analysis and other business intelligence/patent analytics to identify possible infringers. Such market policing also gave the company a proactive approach to identifying licensing opportunities for its CapDI technology and acquiring new clients, such as Atlantis, which Voltea had not been aware of previously. Atlantis eventually took a licence with a supplier agreement for Voltea's technology, which helped to better integrate it with Atlantis's products.

By 2011, Voltea had secured a solid IP position around its core technology, the membrane CDI, to protect its key components and to retain exclusivity for its products in the market. Patents helped to minimise risk when investing in innovation development, protection and exploitation in line with Voltea's funding requirements. The company systematically reviewed new inventions from R&D and sought protection in its current and potential markets.

Growth phase 2: commercially driven

The year 2011 was a turning point for Voltea. The pace of innovation in the field of water deionisation had already doubled compared with 2006 and continued to grow fast during the following years.

TAKEAWAY

EVOLVING IP STRATEGY

The role of IP changes as a company evolves. At an early stage, it is uncertain whether patents might attract the interest of investors. However, at a later stage, investors tend to favour companies ready for higher (IP) governance. That means that patents and IP should be part of the business strategy in order to help companies mature rapidly.

Voltea had to respond swiftly to that change. It did so by securing additional funding to support the commercialisation of its CapDI technology. Voltea executives had a strong commitment to leveraging its IP, which proved to be instrumental at this stage. The company evaluated as yet untapped markets by looking out for niches and new business opportunities in order to develop and protect further commercial applications. Eventually, they realised that the CapDI technology could indeed be applied in industry segments other than washing machines (as initially sought by Unilever R&D). In fact, it brought the same environmental benefits to a wide range of applications, all having the common goal of saving water and reducing energy use.

In terms of exploitation during this phase, IP played a new role as an enabler of commercial co-operation and partnerships, especially with leading players for mass market applications, and this became the largest revenue stream for Voltea. This approach differed from the defen-

sive approach taken in phase 1. Voltea recognised that IP could generate extra value, affording benefits that went beyond securing market shares and royalty fees from licensing. Co-operations and partnerships promoted Voltea's entry into new businesses. It started developing commercial applications for the automotive industry (e.g. water recirculation in a paint line), horticulture and agriculture (recirculating water by removing excess levels of sodium), and residential areas. It began exporting its technology, servicing new markets in the USA, Europe, China, India, Japan and Mexico, while maintaining its presence in Germany, France, Italy, the UK and the Netherlands. Margins were higher in these European markets thanks to a pricing policy based on a premium which was justified by Voltea's unique technology.

Collaborative IP

Because of this expansion across industries and countries, Voltea and its 30 employees quickly reached a limit in terms of in-house R&D capacity. It realised that large companies could provide R&D support, the necessary business networks and distribution channels. For such multinationals, proprietary technology is important for partner selection. A typical example is the 2012 partnership with Pentair for the development of a new electronic water purification system, under which Voltea's technology was licensed exclusively to Pentair for some residential and light commercial applications in the US.

TAKEAWAY

PARTNERSHIPS AND CO-OPERATIONS

Generate extra value via co-operation and partnerships which are enabled by IP. In an integrative strategy, parties collaborate to define and reach a win-win situation by focusing on each other's interests and developing mutually beneficial synergies.

Through co-operation agreements with its partners, Voltea also gains access to IP rights, thereby achieving and maintaining freedom to operate (FTO) for its products. Since it makes its own systems for installations in industrial and commercial markets, securing FTO for its products is important.



The CapDI Development Test Kit allows customers fast and simple exploration of the potential of CapDI systems for their applications.

Managing IP

To respond to these new challenges and growing complexity, Voltea needed to expand its IP portfolio in terms of scope and territorial coverage, and to adapt its IP management accordingly. During phase 2, Piotr Dlugolecki took over as R&D and technology manager. He introduced new systems and processes for senior management to improve day-to-day in-house IP management in co-operation with external IP consultants regarding decisions such as whether or not to file, what to do at the end of priority periods, responses to office actions, payments, and so on.

Voltea focused primarily on the aspects relating to IP capture and protection. In order to generate patentable inventions internally, it organised innovation workshops aimed at protecting promising technology applications. Point-of-entry and point-of-use systems are two prominent examples of applications with high-impact mass-market potential. Both were developed in co-operation with leading partners, who were then still under joint development contracts. Other IP management processes related to keeping notebooks, disclosing inventions, carrying out patent searches, documenting know-how and recording copyright had been introduced as well.

TAKEAWAY

DEVELOPING IP SKILLS

IP professionals need new and advanced skills and tools (e.g. commercialisation and licensing expertise) when it comes to strategic IP management, if they want to keep an active role in the future.

In addition, Voltea also focused on operations associated with IP exploitation such as patent evaluation, competitor watches and FTO analyses. IP evaluation was particularly important, since the value of the company was mostly attributable to its IP, especially during the early years.

Voltea succeeded in growing and exploiting its portfolio as it moved the company from phase 1 to phase 2. The direct results of these changes included the development of the patent portfolio in terms of country and scope. The pace of patenting increased rapidly from the years 2006–2010 (phase 1) to the years 2011–2016 (phase 2). This supported the company's expansion in terms of markets (especially the US and European countries) and applications.

Scenarios for the future

As far as Voltea is concerned, the Unitary Patent is likely to reduce IP management costs such as those relating to renewal fees and translations. It may lead to streamlined administrative steps for patent protection in Europe beyond grant, where the maintenance of files and fees for individual countries is no longer required. The Unified Patent Court (UPC) will establish a harmonised definition and interpretation of patent claim scope throughout Europe, which will bring clarification, simplification and visibility when it comes to deciding on patent protection (similar to the US to a certain extent), leading to a less fragmented protection of Voltea's products and technologies in Europe. In retrospect, if the Unitary Patent had existed when the company transitioned from phase 1 to phase 2, it would probably have helped the company avoid any difficulties regarding the country selection for European patent protection.

In future, Voltea's management will decide on a case-by-case basis, depending on the relevant markets at the time and taking into consideration crucial aspects such as litigation risk and patent strength. As the company also pursues a licensing strategy, the Unitary Patent can secure market opportunities in what are currently peripheral areas.

Furthermore, for Voltea and its integrative approach in phase 2 – seeking co-operation and partnerships with leading players for mass-market applications – the new system will give all parties additional protection thanks to its centralised action against counterfeiting. When the UPC comes into existence, it will help Voltea to police the market, which it currently does by watching competitors and enforcing patents against alleged infringers through legal action in the national courts. The UPC will allow Voltea to obtain a central court action instead, which will create significant efficiencies in the enforcement process.

TAKEAWAY**HOLISTIC IP MANAGEMENT**

Take a holistic approach to IP management, involving planning with other company divisions (marketing, finance, etc.), preferably at executive level. Patents should be treated as part of a larger and complex exploitation system with multiple internal stakeholders.

Voltea continually reassesses its IP management and strategy. Long-term IP investment planning may prepare the company for its next phase of growth, where IP will be used more proactively (driven by the company's long-term goals) rather than reactively (driven by external changes). Voltea is following a holistic approach to IP management, with a forward-looking IP strategy in which management consolidates past IP achievements with those that have already contributed to the company's growth, while preparing for the future. The company is convinced that its IP plan should be developed at board level, rigorously implemented at top management level, and subsequently monitored and adjusted to give a sustainable drive to innovation development, protection and exploitation in an environment with growing competition and complexity.

COMPANY PROFILE**VOLTEA B.V.**

- > Headquarters: Sassenheim, The Netherlands
- > Year of establishment: 2006
- > Staff: 30
- > www.voltea.com

PRODUCTS/SERVICES

CapDI: tunable, low-cost water deionisation technology which removes dissolved salts from water using electrochemistry

MARKET AND TECHNICAL AREA

Global industrial and commercial water treatment markets, residential water softener market

CUSTOMERS

Food and beverage, hotel and resort operators, automotive industry, steel industry, commercial laundry and many others

SELECTED AWARDS

- 2010 Water Technology Idol (Global Water Summit)
- 2013 Blue Truffle Award

PATENT PORTFOLIO

35 patent families, including EP2344423, EP2322486, EP2212254

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