

Federal Court



Cour fédérale

Date: 20110217

Docket: T-219-07

Citation: 2011 FC 174

Toronto, Ontario, February 17, 2011

PRESENT: The Honourable Justice Johanne Gauthier

BETWEEN:

VALENCE TECHNOLOGY, INC.

**Plaintiff
Defendant by Counterclaim**

and

PHOSTECH LITHIUM INC.

**Defendant
Plaintiff by Counterclaim**

**PUBLIC REASONS FOR JUDGMENT AND JUDGMENT
(Confidential Reasons for Judgment issued on February 11, 2011)**

[1] The Plaintiff in this action, Valence Technology, Inc. (Valence), claims its rights under Canadian Patent Nos. 2,395,115 (the '115 Patent), 2,483,918 (the '918 Patent) and 2,466,366 (the '366 Patent) have been infringed by the Defendant (Plaintiff by Counterclaim) Phostech Lithium, Inc. (Phostech) by the manufacture, distribution, offering for sale, sale and use in Canada of lithiated iron phosphate (LiFePO_4) cathode materials.

[2] The Plaintiff, Valence, is an American company, its head office is in Austin, Texas and it is the owner of the '115 Patent, '918 Patent and '366 Patent (the Valence Patents).

[3] The Defendant, Phostech, is a Canadian company which produces its product, carbon-coated lithium iron phosphate (C-LiFePO₄), at its facility in Saint-Bruno-de-Montarville, Quebec, using the “P1 Process”. Phostech was originally a spin off from Hydro-Quebec with funding from the University of Montréal. By 2008, Süd-Chemie, a German company, was the sole shareholder in Phostech.¹ Süd-Chemie is currently building another plant in Quebec to produce C-LiFePO₄ using a different technique (P2 Process), which will be ready in 2012.²

[4] The Valence Patents all relate to processes for the synthesis of lithium mixed metal cathode materials for use in lithium ion batteries, although the ‘918 is wider. The ‘366 is a divisional patent of the ‘115. These patents have a priority date of January 18, 2000 (based on US 09/484,919), a filing date of December 22, 2000 and a publication date of July 26, 2001. The ‘115 was issued on July 20, 2004, while the ‘366 was issued on March 27, 2007 after a voluntary amendment of its claims filed on August 23, 2005. The ‘918 Patent has a priority date of May 17, 2002 (based on US 10/150,343 and 10/150,353), filing date of May 6, 2003 and publication date of December 4, 2003. The ‘918 Patent was issued on January 9, 2007.

[5] In its Amended Statement of Claim,³ Valence alleges 114 claims from the ‘115, ‘918 and ‘366 Patents have been infringed by the Defendant. In its latest Statement of Defence, Phostech alleges that it is not infringing the Valence Patents as its product (C-LiFePO₄) is manufactured pursuant to Canadian Patent No. 2,307,119 (‘119 Patent) and Canadian Patent Application No. 2,423,129 (‘129 Application) for which it holds licences. Phostech also challenges the validity

¹ Testimony of Dr. Michel Gauthier, Transcript of September 9, 2010 at p. 297-298.

² Testimony of Dr. Michel Gauthier, Transcript of September 10, 2010 at p. 46.

³ Amended Statement of Claim (April 2, 2007).

of the Valence Patents and claims that the '918 and '366 Patents misappropriate the '129 Application.

[6] At the pre-trial conference, Phostech confirmed that even if Valence were to reduce the claims on which it was relying, given that the infringement of one claim is sufficient, it still insisted that the Court deal with all 234 claims in the three patents in respect of its counterclaim. At the beginning of trial, Valence reduced its allegations to 39 claims and then on the final day of argument, Valence conceded that if the independent claims of the patents (claim 3 of the '115; claim 26 of the '366 and claim 1 of the '918) are found to be invalid, so too are the dependent claims.⁴ Phostech agreed that for its counterclaim the Court could limit its analysis to only these three claims.⁵ Also, Phostech abandoned its challenge to the validity of the '115 Patent altogether when it became clear that the major piece of prior art relied upon by its expert was not citable prior art.⁶

[7] Pursuant to a Bifurcation Order of Prothonotary Tabib dated June 20, 2007, questions about the extent of infringement, the quantum of damages, accounting of profits or reasonable compensation, if any, are to be determined after trial.

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⁴ Even though this is not necessarily so by law. Final Arguments, Transcript September 30, 2010 at p. 4-5.

⁵ Final Arguments, Transcript of October 1, 2010 at p. 143.

⁶ Final Arguments, Transcript of September 30, 2010 at p. 142.

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General Background

Reduction and Oxidation Reactions

[8] One scientific principle that is critical to this case is the ability of atomic elements (on the periodic table) to exist in different oxidation states and the chemical reactions called reduction or oxidation reactions that change this oxidation state.

[9] The net charge on an atom is referred to as its oxidation state or valence state. Pure elements have an oxidation state of zero (*e.g.* metallic iron can be depicted as Fe^0). Certain atoms can exist in more than one oxidation state (*e.g.* iron can exist in a 2+ or 3+ oxidation state depicted as Fe^{2+} or Fe^{3+} respectively). Typically, the transition metals of the periodic table (which include iron) are able to support multiple valence states.

[10] The oxidation state of an atom can change upon reaction with another atom via an oxidation or reduction reaction. In a reduction reaction, the atom gains an electron (or multiple electrons)

during its reaction with another atom and its oxidation state is reduced. For example, Fe^{3+} can be reduced to Fe^{2+} by a gain of one negatively-charged electron. Alternatively, in an oxidation reaction, an atom loses electrons during its reaction with another atom and its oxidation state will increase due to the loss of the electron(s). For example, Fe^{2+} minus one electron will be oxidized to Fe^{3+} . Typically, when metallic Fe^0 reacts with air, it will be oxidized (loss of electrons) to Fe^{3+} .

[11] Certain properties of carbon are commonly agreed to. Carbon (represented by “C” on the periodic table) can exist in a variety of forms, such as amorphous carbon (carbon black), graphite and diamond. Carbon is also “the backbone of all organic compounds”, including organic polymers (“high molecular weight molecule[s] comprised of a series of repeating linked units”).⁷

[12] In carbothermal reduction (CTR), carbon reduces a compound, which involves the production of carbon monoxide (CO) or carbon dioxide (CO_2) as an effluent gas. The amount of CO or CO_2 that will be produced depends on the temperature of the reaction. In carbon monoxide gas, the carbon atom is in a 2+ oxidation state and has 2 electrons available to donate to neighbouring atoms, whereas in carbon dioxide gas, the carbon atom is in a 4+ oxidation state and has no electrons to donate.⁸

Battery Science and Composition

[13] A lithium-ion battery is composed of one or more electrochemical cells. Each cell is made up of an anode (negative electrode), a cathode (positive electrode), an electrolyte which allows for the transport of charged lithium ions (*e.g.* Li^+) and a current collector.

⁷ Exhibit V-5 at para. 26.

⁸ Exhibit V-5 at para. 25

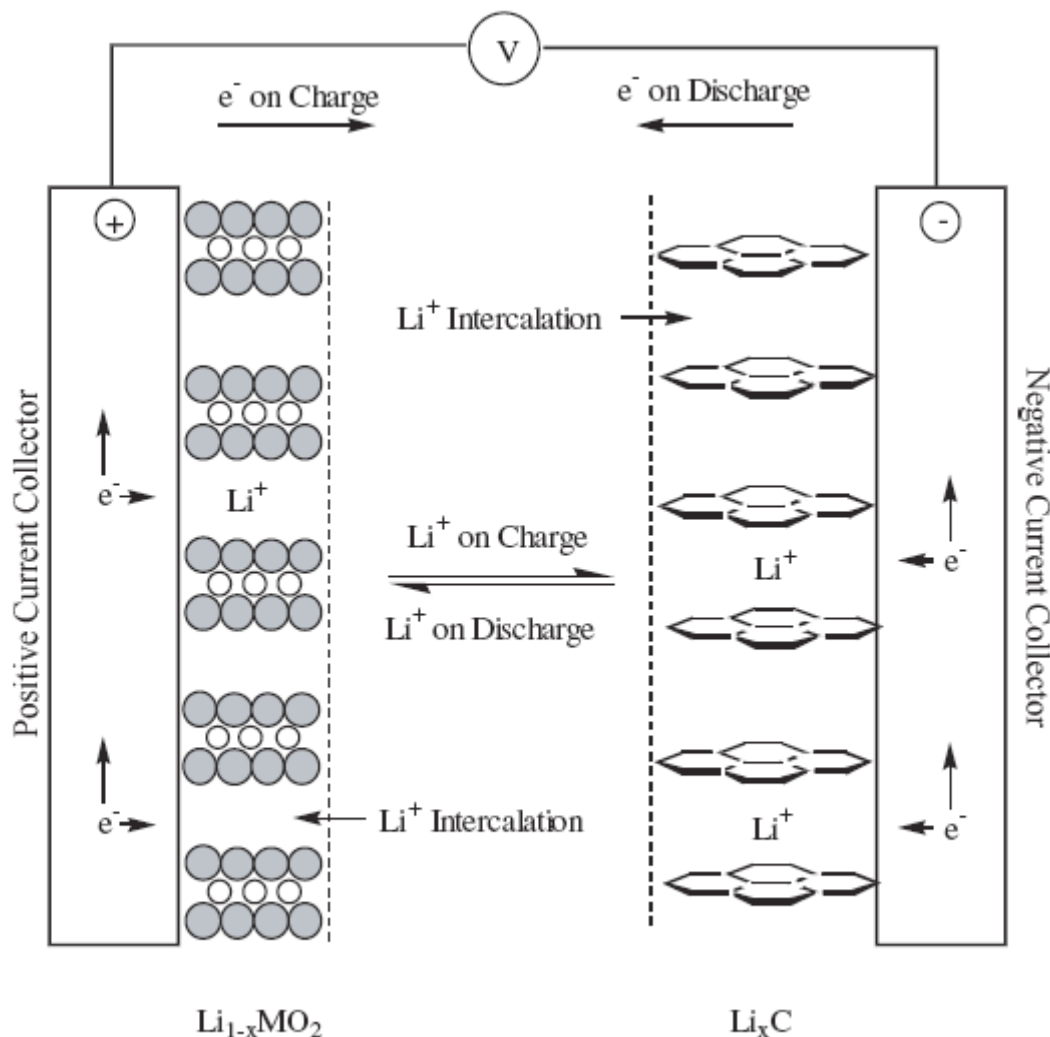


FIGURE 35.3 Schematic of the electrochemical process in a Li-ion cell.

(Figure from D. Linden and T.B. Reddy, eds., *Handbook of Batteries*, 3d (New York: McGraw-Hill, 2001) reproduced in Exhibit V-5)

[14] The right side of the above figure shows the anode, which is usually comprised of graphite layers (*i.e.* carbon) depicted as hexagons. Lithium can be stored in between these graphite layers. The anode is attached to copper foil using a binding material. The centre of the battery is an electrolyte (liquid) containing a dissolved lithium salt. On the left side of the figure is the cathode, in this case, a lithium metal oxide, made up of layers of oxygen with layers of a metal in between.

There are spaces in between the layers for lithium to reside. The lithium metal oxide is attached to an aluminum current collector.

[15] The battery operates by the transfer of lithium ions from the graphite (where lithium binds only very weakly to carbon) in the anode to the metal oxide (where lithium is strongly attracted to oxygen) in the cathode. When a wire is attached connecting the negative anode to the positive cathode, the lithium ions move through the electrolyte and electrons move through the wire to the cathode which provides an electrical current that is ultimately used to power a device. Basically, the lithium moves from between the graphite layers to the layers of the lithium metal oxide. To recharge the battery, electrons are forced in the opposite direction and the lithium ions and electrons go back to the anode.

[16] Oxidation and reduction reactions occur during the charge and discharge of a battery when lithium moves from the anode to the cathode and vice versa. For illustration purposes, assume a battery uses lithium iron phosphate for its cathode material. The iron in the LiFePO_4 is in the 2+ oxidation state. Iron in ferric phosphate (FePO_4) is in the 3+ oxidation state. Thus, on discharge of the battery, lithium is inserted into the FePO_4 of the cathode, which reduces FePO_4 to LiFePO_4 . Upon charging the battery, the opposite reaction occurs. Lithium is extracted from the cathode which oxidizes the LiFePO_4 to FePO_4 .

[17] It is important that lithium insertion into the cathode material does not significantly perturb the structure of the cathode. For example, it has been noted that battery cells using LiFePO_4 as a cathode material have excellent reversibility on repeated cycling (ability to charge and discharge)

because the structures of FePO_4 (lithium extracted) and LiFePO_4 (lithium inserted) are very similar.⁹ Thus, the choice of the cathode material is a critical factor for a battery with a long life cycle.

[18] Among the common choices of cathode materials there are “trade-offs between the relative importance of cost, power, energy and thermal stability”.¹⁰

[19] Aside from the choice of cathode material, other factors which are important to the manufacture of a battery include cost, the availability of starting materials, environmental impacts and manufacturability.¹¹

Development of cathode materials for lithium ion batteries

[20] Lithium ion batteries are used in virtually all portable electronic devices that are rechargeable, including laptop computers, cellular telephones and digital cameras. These batteries are also now used in many battery-powered tools, such as drills or saws and are being used in e-bikes and scooters. Lithium ion battery technology is widely accepted due to “its unique ability to offer a high level of performance in many aspects, including energy density, specific energy, specific power, cycle life, storage life and temperature range, in a safe, low-cost product.”¹²

[21] Although lithium battery research commenced in the late 1960s to early 1970s,¹³ significant developments in the field were not made until 1980 when Dr. Goodenough discovered that lithium

⁹ A.K. Padhi, K.S. Nanjundaswamy and J.B. Goodenough, “Phospho-olivines as Positive-Electrode Materials for Rechargeable Lithium Batteries” (1997) 144 J. Electrochem. Soc. 1188 at 1191 (Exhibit P-27 at p. 332-338).

¹⁰ Exhibit V-5 at para. 20.

¹¹ Exhibit V-20 at para. 24.

¹² Exhibit V-5 at para. 20.

¹³ Exhibit P-27 at p. 3.

cobalt oxide (LiCoO₂) had favourable properties for use as a cathode material in rechargeable batteries.¹⁴ Sony Corporation built on this discovery and the first commercially successful lithium ion battery was introduced in 1991.¹⁵ When compared to previous rechargeable batteries, the lithium ion battery obtained higher energy and voltage and a significantly longer life cycle.¹⁶

[22] While LiCoO₂ had a long life cycle and excellent capacity, cobalt was not an ideal material because it “is in limited supply in nature, is relatively expensive and is regarded as not being environmentally benign.”¹⁷ Thus, researchers began studying other cathode materials (transition metal oxides) to replace cobalt.¹⁸ Researchers, particularly those in Japan, pursued iron oxides as potential cathode materials with little success.¹⁹

[23] The use of transition metals posed certain challenges, such as “maintaining the transition metal in the correct oxidation state and in a non-oxidizing atmosphere”.²⁰ Thus, researchers commonly used materials which contained their transition metal in the desired oxidation state.²¹

[24] In 1997, Dr. Goodenough’s group at the University of Texas reported LiFePO₄ as an excellent new candidate for the cathode material.²² That said, in January 2000, commercialized

¹⁴ M. Stanley Whittingham, “Lithium Batteries and Cathode Materials” (2004) 104 *Chem Rev* 4271 at 4280 (Exhibit P-27, p. 291-321)

¹⁵ Exhibit V-20 at para. 25.

¹⁶ Exhibit V-20 at para. 25.

¹⁷ Exhibit V-20 at para. 26.

¹⁸ Exhibit V-20 at para. 27.

¹⁹ M. Stanley Whittingham, “Lithium Batteries and Cathode Materials” (2004) 104 *Chem Rev* 4271 at 4293 (Exhibit P-27, p. 291-321).

²⁰ Exhibit V-20 at para. 31.

²¹ Exhibit V-20 at para. 31.

²² *Ibid.*

batteries still used only lithium cobalt oxide, lithium nickel oxide and lithium manganese as a cathode material.²³

[25] Researchers have since improved the capacity of the lithium iron phosphate battery. A witness for Phostech explained that the lithium iron battery business started in 2001 as a \$2 billion business, today is about \$8 billion and by 2020 is expected to be roughly a \$40 billion business.²⁴ The lithium iron battery is important as it is, effectively, an alternative to carbon (*i.e.* fossil fuels) as a way to store energy and is also used for large-scale applications, such as transportation.²⁵

The Evidence

[26] The parties submitted a list of admissions,²⁶ extracts from discovery (Valence: Exhibit V-11 and Phostech: Exhibits P36A to P36F) and an Agreed Chronology of Events (see Annex B).

[27] In respect of infringement, Valence put forth one lay witness, Mr. Randall J. Adleman, and one expert, Dr. Jeffery Dahn. In response to Phostech's arguments on invalidity, Valence put forth two experts, Dr. Elton Cairns and Dr. Dane Morgan.

[28] Phostech presented three lay witnesses, Mr. Denis Geoffroy, Dr. Nathalie Ravet and Dr. Michel Gauthier, one expert on infringement, Dr. Christopher Bale, and one expert on validity, Dr. Michael Stanley Whittingham.

²³ Exhibit V-20 at para. 33.

²⁴ Testimony of Dr. Michel Gauthier, Transcript of September 9, 2010 at p. 298.

²⁵ Testimony of Dr. Michel Gauthier, Transcript of September 9, 2010 at p. 298-299.

²⁶ Particularized List of Admissions by Phostech (April 3, 2009), Valence's Response (April 22, 2009) and Admission by Phostech (November 11, 2009).

[29] Mr. Adleman has been the Vice-President of Sales and Marketing at Valence Technology, Inc. since March 2010.

[30] The main purpose of his testimony was to explain Valence's current business of supplying high performance lithium phosphate energy systems, including lithium phosphate batteries (whose cathode material is manufactured by Valence's plants in China) and battery management systems to customers worldwide. Valence has divisions in the United States (Austin, TX and Las Vegas, NV) and the United Kingdom.

[31] He also explained that Valence used to manufacture its cathode material using lithium oxides, but due to safety issues (*i.e.* thermal runaway) and the potential for increased cyclability, the company switched to lithium phosphate materials. Although Valence has been around since 1989, its main focus was on research and development until it commercialized its products around 5 years ago.

[32] Mr. Geoffroy is the Technical Director at Phostech in charge of production, engineering, maintenance and purchase of materials. Although his background is in Chemical engineering (Master's degree, 1996), when he joined Phostech in 2002, he worked for three years on the development of the business (*e.g.* sales and location of business partners).

[33] The main purpose of Mr. Geoffroy's testimony was to confirm the details of Phostech's P1 Process (given that details of this process are protected by the Confidentiality Order of Prothonotary

Tabib,²⁷ the information relied upon by the Court will be explained in Confidential Annex A).

Mr. Geoffroy also produced two samples from the Phostech P1 Process: the mixture of the ferric phosphate and lithium carbonate powders (Exhibit P-3) and the final product C-LiFePO₄ (Exhibit P-4).

[34] Dr. Nathalie Ravet is responsible for quality control at Phostech. She holds a Ph.D. (1994) in Electrochemistry. Although she officially began working for Phostech in 2007, prior to that she was part of Professor Michel Armand's team at the University of Montreal where she also worked on the electrochemical portion of Phostech's quality control.

[35] The main focus of Dr. Ravet's testimony concerned her past research on LiFePO₄, her various publications, presentations and posters on the subject and her involvement with Hydro-Québec's '119 Patent (Exhibit P-14), '129 Application (Exhibit P-18) and Canadian Patent Application No. 2,320,661 ('661 Application) (Exhibit P-20). These are cited as part of the prior art relied upon by Phostech and are allegedly the basis for the P1 Process.²⁸

[36] Dr. Ravet testified that her experience working on the compound LiFePO₄ began in 1998. At that time, Dr. Armand and Hydro-Québec had already established a collaboration with Dr. Goodenough's group at the University of Texas.²⁹ In 1998, Dr. Armand's lab was using a single-step synthesis process for LiFePO₄ using an iron precursor where iron was in the 2+ oxidation state; they then moved to a two-step synthesis with the intention to optimize each of the

²⁷ January 8, 2008 and amended January 4, 2010.

²⁸ The Court does not have to make a finding of fact in this respect.

²⁹ Testimony of Dr. Nathalie Ravet, Transcript of September 9, 2010 at p. 51.

steps.³⁰ Dr. Ravet's goal was to find a different synthesis mechanism for LiFePO₄, other than that proposed by Dr. Goodenough, since the precursor materials in that mechanism (*i.e.* precursors starting from Fe²⁺) were very expensive.³¹ Because Hydro-Québec was interested in commercializing its own battery, Dr. Ravet's team was involved in upgrading the LiFePO₄ production process.³²

[37] Dr. Ravet spoke about the very first time she presented her research on LiFePO₄, which was in Honolulu, Hawaii, for the 196th Meeting of the Electrochemical Society (October 17 – 22, 1999). Since this was her first time speaking at a conference in English, her second language, she learned her presentation by heart and testified that her transparencies were a true indication of what she said during the presentation (see her abstract and overhead transparencies (Exhibit P-11)).³³ She was very specific that she did not speak about the synthesis mechanism for LiFePO₄ nor of the use of carbon or sugar, rather she focused on the improved electronic conductivity of one of the samples.³⁴ She noted, however, that after her talk she read articles that referred to her presentation as [translation] “the moment at which it was revealed that she had obtained a carbon deposit coming from the decomposition of an organic material” but she was clear that this is simply not so.³⁵

[38] In that respect, Dr. Ravet presented a poster at the 10th International Meeting on Lithium Batteries in Como, Italy (May 28 – June 2, 2000). The poster (since destroyed) contained the words

³⁰ Testimony of Dr. Nathalie Ravet, Transcript of September 9, 2010 at p. 221-222.

³¹ Testimony of Dr. Nathalie Ravet, Transcript of September 9, 2010 at p. 52.

³² Testimony of Dr. Nathalie Ravet, Transcript of September 9, 2010 at p. 52-53.

³³ Testimony of Dr. Nathalie Ravet, Transcript of September 9, 2010 at p. 98.

³⁴ Testimony of Dr. Nathalie Ravet, Transcript of September 9, 2010 at p. 87-92, 96.

³⁵ Actual transcript reads: “j’ai lu des articles qui référaient à cette présentation comme étant le moment où on avait révélé le depot de carbone obtenu d’une matière – par décomposition d’une matière organique et c’est pas vrai.” (Testimony of Dr. Nathalie Ravet, Transcript of September 9, 2010 at p. 96).

“carbon coating”³⁶ and during the poster session she answered questions from those interested and may have discussed sugar. In July 2000, she published a short article explaining her results which was accepted January 29, 2001 and published in July 2001 (Exhibit P-15).³⁷ The article was the first publication where they divulged having realized a carbon deposit using a carbon precursor on LiFePO_4 “already synthesized”.³⁸

[39] After submission of the Como article in the summer of 2000, Dr. Armand’s lab scaled up its research on a single-step process using a Fe^{3+} precursor,³⁹ since there were many problems with Fe^{2+} oxidation.⁴⁰ At that time, the lab used externally applied gaseous reducing atmospheres including a CO/CO_2 combination, ammonia and hydrogen.⁴¹

[40] During cross-examination, Dr. Ravet addressed an abstract written by Dr. Zaghbi of the Institut de Recherche d’Hydro-Québec, which lists her and Michel Gauthier as co-authors (Exhibit V-14). She admitted that Phostech at the time, between 2006 and 2007, was indicating to the public that it was making LiFePO_4 in a process that was reducing Fe^{3+} to Fe^{2+} by way of the “carbo-thermal effect”;⁴² however, she does not agree with what was written.⁴³

³⁶ Testimony of Dr. Nathalie Ravet, Transcript of September 9, 2010 at p. 141.

³⁷ N. Ravet *et al.*, “Electroactivity of natural and synthetic triphylite” (2001) 97-98 J. Power Sources 503; Testimony of Dr. Nathalie Ravet, Transcript of September 9, 2010 at p. 145-146.

³⁸ Testimony of Dr. Nathalie Ravet, Transcript of September 9, 2010 at p. 147.

³⁹ Testimony of Dr. Nathalie Ravet, Transcript of September 9, 2010 at p. 222-227.

⁴⁰ Testimony of Dr. Nathalie Ravet, Transcript of September 9, 2010 at p. 154-156.

⁴¹ Testimony of Dr. Nathalie Ravet, Transcript of September 9, 2010 at p. 222-227.

⁴² Testimony of Dr. Nathalie Ravet, Transcript of September 9, 2010 at p. 266.

⁴³ Testimony of Dr. Nathalie Ravet, Transcript of September 9, 2010 at p. 269.

[41] Dr. Michel Gauthier was President of Phostech since its creation in 2001 until June 2009. After that time he agreed to continue to represent Phostech for the needs of the litigation.⁴⁴

[42] Dr. Gauthier holds a Ph.D. (1970) in Electrochemistry. He has worked in the field of lithium batteries for 30 to 35 years. During his 27-year employment at the Hydro-Québec Research Centre (HYREC) he introduced and developed the company's lithium battery technology.⁴⁵

[43] He testified about his involvement and contribution to the various patents licensed to Phostech ('119 Patent, '129 Application and Canadian Patent Application No. 2,422,446 ('446 Application)), the litigation history and Phostech's past relationship with Valence. He also discussed how Phostech attempted to determine whether or not it was infringing the Valence Patents through various tests. Finally, he testified in support of the misappropriation arguments of the Defendant, pursuant to s. 53 of the *Patent Act*, RSC 1985, c P-4.

[44] Like the other factual witnesses, Dr. Gauthier was a credible witness and the Court has no reason to believe that Phostech was acting in bad faith when it chose its P1 Process or continued to use it after receiving the letter of demand from Valence.

[45] In relation to Phostech's arguments with regards to misappropriation (ss. 53(1) of the *Patent Act*), Phostech's position is based on its belief that Valence's patent agent clearly incorporated the claims of Hydro-Québec's application ('129) into the claims of the '366 Patent, including the use of the term "C-LiFePO₄" in claim 73, which it alleges was taken from the '446 Application.

⁴⁴ Testimony of Dr. Michel Gauthier, Transcript of September 9, 2010 at p. 279-281.

⁴⁵ Testimony of Dr. Michel Gauthier, Transcript of September 9, 2010 at p. 281.

[46] Finally, Dr. Gauthier explained how a declaration of infringement and an injunction preventing the use of the P1 Process before the P2 Process is operational in 2012 would impact Phostech's 55 employees and its ability to compete in the Asian markets, where most of its product is sold.⁴⁶

[47] Valence's expert on infringement, Dr. Jeffery Dahn, holds a Ph.D. in Physics (1982) and has been a professor in the Physics Department at Dalhousie University in Nova Scotia since 1996 with a cross-appointment in the Chemistry Department. He has had extensive experience in the area of lithium ion battery research and has won multiple awards for his work and for his teaching appointments. Dr. Dahn has authored several hundred papers dealing with lithium ion batteries and he recently completed a chapter on the subject for the 4th edition of the *Handbook of Batteries*.⁴⁷

[48] Dr. Dahn was qualified as an expert in lithium ion batteries and the processes and materials involved in making the cathode materials for lithium ion batteries. He filed 3 expert reports. His first report (Exhibit V-5) deals with claims construction and infringement of the Valence Patents. In this report, he analyzes the experimental work, including thermogravimetric analysis (TGA) and x-ray diffraction (XRD), conducted by Canmet ENERGY to evaluate the P1 Process (Exhibit V-5, Tab O). His second report (Exhibit V-6) is a supplement to the first report which addresses additional facts concerning some specifications of the Phostech kiln and P1 Process which came to

⁴⁶ Testimony of Dr. Michel Gauthier, Transcript of September 9, 2010 at p. 298-303.

⁴⁷ Dr. Dahn, who was also approached by Phostech in preparation for the litigation, is clearly an eminent expert in the field of lithium batteries, a fact confirmed by Dr. Whittingham.

light after he drafted his first report. Finally, Dr. Dahn's third report (Exhibit V-7) replies to Dr. Bale's first two reports (Exhibits P-6, P-7). He comments on the results of the testing conducted by Dr. Bale on Phostech's commercial materials and the test performed by Dr. Bale in Exhibit P-7 (Dr. Bale's Vapour Test). He also responds to criticisms from Dr. Bale concerning the Canmet ENERGY testing (namely, improper particle size) and explains additional testing done by Canmet ENERGY (V-7, Tab A) to rectify these concerns and to demonstrate that the TGA results of Dr. Bale and those of Canmet are equivalent.

[49] Despite Phostech's attempts to impugn the credibility of this expert and the weight to be given to his evidence (see para. 165), the Court found him to be a particularly credible and compelling witness whose explanations were clear and straight-forward.

[50] Phostech's expert on infringement, Dr. Christopher Bale, holds a Ph.D. in Engineering (1973). He is a retired professor from the Université de Montréal (École Polytechnique de Montréal) where he taught in the Department of Metallurgical Engineering since 1977 at both the graduate and undergraduate levels. He is also the co-founder and co-Director of the Centre de Recherche en Calcul Thermochimique which develops and sells software that utilizes thermochemical properties from experimentation and manipulates them to calculate and plot results or predict systems not yet in existence. Dr. Bale has over 35 years experience in chemistry, chemical metallurgy and related fields and his principal areas of expertise are thermochemistry and chemical processes simulation.

[51] Dr. Bale was qualified as an expert in the field of thermochemistry and thermodynamics aspects of chemical and materials science as well as an expert in the field of the analysis and simulation of processes used in the production of materials. Although the parties did not challenge the qualification of the experts at trial, Valence sought to clarify that “materials” in his case did not include lithium iron phosphate materials as Dr. Bale has never worked with this type of battery material.⁴⁸

[52] There is no dispute that Dr. Bale cannot attest to what a **p**erson of **o**rdinary skill in the **a**rt (posita) would commonly know or how he or she would understand the patents at issue. In that respect, he had to rely entirely on Dr. Whittingham’s opinion.

[53] Like Dr. Dahn, Dr. Bale filed 3 expert reports. His first report (Exhibit P-6) primarily concerns the issue of infringement of the Valence Patents by the P1 Process. Dr. Bale discusses experimental testing he performed to analyze the Phostech P1 Process precursors and final product, including TGA, XRD, differential scanning calorimetry (DSC), mass spectrometry (MS) and scanning electron microscopy (SEM). In his second report (Exhibit P-7), Dr. Bale responds to Dr. Dahn’s first report (V-5) and discusses an additional test he performed to show that FePO_4 could be reduced by polymer vapours (Dr. Bale’s Vapour Test, P-7 Annex). His final report (Exhibit P-8) is a supplement to his responding report and discusses additional experimental testing conducted on Phostech’s commercial product (combined MS-TGA-DSC experiments).

[54] Essentially, the disagreement between these experts was as to whether or not the reduction of the Fe^{3+} in the P1 Process is effectively done by CTR. According to Dr. Bale, by the time (and

⁴⁸ Transcript of September 7, 2010 at p. 27.

temperature) that carbon (the carbon residue from the pyrolysis of the polymer used in the P1 Process) could become active, iron reduction would have already been completed by the gases, the precise composition of which is not entirely known. For Dr. Dahn, considering the particulars of the P1 Process, although a very minor fraction of the iron may be reduced by the gases produced during the pyrolysis of the organic polymer used by Phostech, the reduction process is CTR and the P1 Process includes all the essential elements of the claims at issue.

[55] Turning to the invalidity arguments and the counterclaim, Phostech presented Dr. Michael Stanley Whittingham, who holds a Ph.D. in Chemistry with a specialization in solid state chemistry (1968). Dr. Whittingham is currently a professor in Chemistry and Materials Science & Engineering at Binghamton University in New York where he teaches at the undergraduate and graduate level. His past experience includes the development of lithium ion battery materials and multiple publications in the area, including a review of lithium batteries and cathode materials published in 2004 (Exhibit P-27, p. 291-321). Dr. Whittingham was qualified as an expert in the field of the preparation of lithium ion battery materials as well as the field of the chemical and physical analysis of the properties of these materials. Dr. Whittingham is especially known in his field for the hydrothermal technique for synthesis of lithium iron phosphates, which is essentially the P2 Process that will shortly be used by Phostech at its new installation.

[56] Dr. Whittingham filed 3 reports. His first report (Exhibit P-27) deals with construction of the Valence Patents and, in his opinion, that all these patents are invalid on the basis of obviousness, anticipation and lack of sound prediction; he also claims overbreadth, misappropriation and lack of utility (for the '366), overbreadth (for the '115) and double patenting (for the '918). He provides a

historical background on lithium rechargeable batteries. He also discusses what he views as plagiarism even though the Court did not accept him as an expert on this subject.⁴⁹ His second report (Exhibit P-28) responds to the report of Dr. Dahn on certain aspects of claims construction, while his third report (Exhibit P-38) responds to the expert reports of Drs. Cairns and Morgan and deals particularly with the passages at page 13 line 14 to page 14 line 2 of the '115 and '366.

[57] Dr. Elton J. Cairns holds a Ph.D. in Chemical Engineering (1959). He has conducted research on lithium ion cells and electrode materials for the past 20 years. His research has covered the preparation and characterization of electrode materials for lithium batteries, mostly for the cathode. He was the editor of two major electrochemical journals: *The Journal of the Electrochemical Society* and *Electrochimica Acta* and the president of both the International Society for Electrochemistry and the Electrochemical Society. Dr. Cairns was qualified as an expert in electrochemistry and lithium ion batteries.

[58] Dr. Cairns submitted one report (Exhibit V-20). This report deals with claims construction and the validity of the Valence Patents and responds to Dr. Whittingham's first report on these issues. He also provides background on battery science and a brief history of the development of cathode materials for lithium ion cells.

[59] Valence's second expert on validity, Dr. Morgan, holds a Ph.D. in Physics (1998). From 1998 to 2004 he was in the Department of Materials Science and Engineering at the Massachusetts Institute of Technology studying lithium ion batteries and modeling their thermodynamics and kinetic properties. He has been teaching since 2004 in the Department of Materials Science and

⁴⁹ The Court does not require any help in that respect (*R v Mohan*, [1994] 2 SCR 9).

Engineering at the University of Wisconsin in Madison, where he is now an Associate Professor.

His work includes the thermodynamics and kinetic properties of battery materials, with a particular focus on lithium battery materials (lithium iron phosphate) and processes of lithium intercalation.

He was qualified as an expert in the materials science of lithium ion batteries.

[60] Although Dr. Morgan prepared an extensive report (Exhibit V-24), at trial, only certain paragraphs of his report were entered into evidence (paragraphs 1-50, 85-90, 113-128, 161-164, 182) to avoid duplication, an issue that had been raised by Phostech earlier in the process.

[61] The parties are agreed that all these experts were well qualified to deal with all the issues discussed in their reports (except for plagiarism for Dr. Whittingham and common general knowledge of the posita by Dr. Bale). I agree. Although they were all credible witnesses, the Court in the end gave less weight to the opinions of Drs. Bale and Whittingham for a variety of reasons that will be discussed later on. Dr. Bale's testimony was not particularly clear and he had some difficulty focusing on the real issues in dispute. It may well be that this was simply his lack of experience with the litigation process. I must say that I was not particularly impressed by the testimony of Dr. Whittingham.

1. Claims Construction

i. The Principles

[62] The principles applicable to the construction of patent claims are well-known. I will thus refer simply to what I said in *Eli Lilly*, 2009 FC 991 at paragraph 87 and 88:

87 Before considering the allegations of infringement and invalidity, the Court must construe the claims at issue in this

proceeding. The principles of construction are well-established. They are set out in *Free World Trust v. Electro Santé Inc.* 2000 SCC 66, [2000] 2 S.C.R. 1024 (*Free World Trust*), and *Whirlpool Corp. v. Camco Inc.* 2000 SCC 67, [2000] 2 S.C.R. 1067 (*Whirlpool*). Since those decisions were issued, much has been written by this Court on this topic. Be it sufficient to say that "[t]he key to purposive construction is therefore the identification by the court, with the assistance of the skilled reader, of the particular words and phrases in the claims that describe what the inventor considered to be the "essential" elements of his invention." As to the further details of what date the claims are to be construed, using what criteria, what resources, through whose eyes and what is made of the resulting construction, the Court adopts and refers to paras. 32-48 of Justice Roger Hughes' decision in *Pfizer Canada Inc. v. Canada (Minister of Health)*, 2005 FC 1725, 285 F.T.R. 1.

88 As noted in *Shire Biochem Inc. v. Canada (Minister of Health)*, 2008 FC 538, 328 F.T.R. 123, at para. 21 (Shire), the Court "is not to construe a claim without knowing where disputes between the parties lie." ... [Footnotes omitted.]

[63] There was no real disagreement between the parties in this respect⁵⁰ except maybe that Phostech argues that, in this case, the examples of the patent, particularly those in the '115 and '366 Patents, are very useful to define how certain expressions such as "carbon" would be understood. The Defendant referred to *Janssen-Ortho Inc v Novopharm Ltd*, 2006 FC 1234, aff'd 2007 FCA 217.

[64] The Court will obviously consider the examples in the patents under review as they are part of their specifications. However, one must be cautious not to rely too heavily on these for they are just as their description implies "examples" of some of the embodiments of the invention, and, as

⁵⁰ See Plan de Plaidoirie de Phostech, at paras 68-76; Primer of Law of the Plaintiff, at paras 1-9.

mentioned in most patents, they are not usually meant to limit the monopoly defined in the claims (see for example p. 35, line 19 - 21 of the '115 Patent).⁵¹

[65] As these patents were all filed after October 1st, 1989, they are subject to the *Patent Act*, RS 1985, c P-4 (sometimes still referred to as the New Act). They must be construed as of the date of the publication of the application. Thus, the Court must take into consideration the common general knowledge of the posita as of July 26, 2001 for the '115 and the '366 Patents, and December 4, 2003 for the '918 Patent.

ii. Posita

[66] It is not disputed that the posita in this case would be familiar with the technology involved in these patents and would understand how to conduct the method(s) described therein.

[67] Although there was some debate as to whether one should include in the definition of the posita, a person who would have a B.Sc. or graduate degree in physics⁵² as opposed to electrical chemistry or materials science; by the end of the trial, it was clear that Phostech agrees that such persons would be included, noting however, that a notional individual with a background in physics may need a few more years of practical experience in the field of lithium batteries. In my view, this is covered by the 3-5 years of experience discussed below.

⁵¹ In *Janssen-Ortho Inc.* above, Justice Roger Hughes construed claim 4 to cover the substance “in a reasonably pure state”. As noted by the Federal Court of Appeal at paras 14 to 18, he did so not only on the basis of the examples but based upon the preponderance of the relevant expert evidence before him.

⁵² In the real world, some of the best known researchers in the field such as Dr. Dahn and Dr. Goodenough hold a Ph.D. degree in this discipline.

[68] I thus accept the following definition of the posita proposed by Dr. Cairns: a person with a B.Sc. in materials science, electrochemistry, physics or physical chemistry and between three to five years of work experience in the field of lithium batteries, or a graduate degree (Masters or Ph.D.) on a subject related to the field of lithium batteries. Obviously, if the graduate degree was obtained in a field other than lithium batteries (thesis) then the graduate would also need to have some practical experience in the relevant field.

[69] Finally, the notional posita is assumed to keep up-to-date in his field. However, it would appear that in this particular field, those actually practicing keep up to date mostly through reviewing publications and leading journals rather than reviewing patent applications.

iii. Common general knowledge

[70] The Court is satisfied that the posita would generally know that carbon is a reducing agent used to reduce metals to their elemental state (see also p. 60 of the '115 and '366 Patents). Dr. Bale testified that CTR is not a subject that is normally taught in chemistry, it is taught in engineering (see Transcript of September 7, 2010 at p. 45-46). He noted that this topic is also taught at the undergraduate and graduate level to chemical metallurgists. I understand from this and from the other evidence before me that the posita's knowledge in this respect would be general and not as detailed as that of a metallurgist or chemical engineer. The posita would be generally familiar with the Ellingham Diagram discussed by Dr. Bale and would have generally known that hydrogen gas could be used as a reducing agent.

[71] Although it was known that carbon produces gases such as CO and CO₂ when in contact with oxygen, it was commonly known that pure carbon cannot exist as a gas or a liquid in normal atmospheric pressure or at temperatures less than 3,600°C.⁵³

[72] Obviously, the posita would be aware of all the general background information described in the patents and the section entitled “Background” in these reasons in respect of rechargeable batteries including the information described in the following paragraphs of exhibits filed by the parties which were admitted to be part of the relevant common general knowledge (Exhibit V-24: Report of Dr. Morgan, paras 10 to 27, 29, 30, 32; Exhibit V-20: Report of Dr. Cairns, paras 10 to 29, 31, 33, 35, 36; Exhibit V-5: Report of Dr. Dahn, paras 13 to 17, 19 to 27; Exhibit P-27: Report of Dr. Whittingham, “Background” section, part 1; Exhibit P-6: Report of Dr. Bale, section 2.1.1(i)(ii) and (iii) and 2.2.2, excluding the attachment referenced therein).

[73] Prior to 2000, the only synthesis method commonly known and in fact used to make lithium iron phosphate cathode materials was from a ferrous phosphate precursor, where the iron is in a +2 oxidation state and where this valency was maintained throughout the synthesis by using a non-oxidizing atmosphere.

[74] It was known to the posita that in making a lithium battery cell (both the anode and the cathode), one normally used carbonaceous material such as graphite and carbon black as well as

⁵³ See para. 80(d) of Phostech’s Plan de plaidoirie, which was admitted by Valence.

binders. In the cathode, ground up carbon black was added to the active material to improve its electrical conductivity.⁵⁴

[75] The Court is also satisfied that it has been established through the testimony of Dr. Dahn,⁵⁵ who referred to standard publications such as a textbook entitled *Chemistry and Physics of Carbon* published in 1971 (Exhibit V-5, Tab R, p. 318), that it was generally known that many polymers decompose to yield carbonaceous material or a carbon residue as a result of pyrolysis.⁵⁶

[76] Considering what common general knowledge is (see *Eli Lilly*, above, at paras 96 - 100), the Court does not accept that it has been established to its satisfaction that what Dr. Ravet or any member of her research team said at the Honolulu conference became part of the common general knowledge in 1999, that is, prior to the first article she and her team published in July 2001. Also, as it is not clear exactly when in July this publication would have been circulated to the notional posita, the Court cannot assume that what one finds in that article (Exhibit P-15) was part of the common general knowledge the posita would have had in mind when reading the application for the '115 Patent in July 2001.⁵⁷

⁵⁴ See Exhibit P-27, p. 332-338 (Padhi article, *supra*, note 9) at p. 334 under "Experimental"; Exhibit P-27, p. 187-189 at p. 188 (H. Huang, S.-C. Yin and L.F. Nazar, "Approaching Theoretical Capacity of LiFePO₄ at Room Temperature at High Rates" (2001) 4 *Elect. Sol. State Lett.* A170); '119 Patent, p. 2, line 19 *et seq.* It appears that even with active material which includes excess carbon in the final product, one would still add carbon black when constructing the cathode (see '115 Patent, p. 31, line 33 *et seq.*, p 57, line 16 *et seq.*, p. 46, line 26-28, see also '119 Patent, examples 1, 6, 7, 8 and 14 and '129 Application, example 1'' and 10').

⁵⁵ See also testimony of Dr. Cairns, Transcript of September 14th, 2010 at p. 190; Exhibit V-20, at para 207.

⁵⁶ Pyrolysis means the heating of a polymer in an atmosphere with no oxygen, whereas one could refer to the same reaction as burning if done in open air.

⁵⁷ The application for the '119 Patent published on October 30th, 2000 as well as the abstract in the article published in July 2001 (Exhibit P-15) may still be relevant as prior art, but this will be discussed later while reviewing the validity of the patents at issue.

[77] The Court finally notes that it had to be particularly careful with the evidence of Dr. Whittingham with respect to what was well-known and generally accepted by the posita. In effect, this expert admitted that he was not careful in his choice of words in this respect. In his report, he sometimes included knowledge that is available now as opposed to at the publication date of the patents at issue (see for e.g. Exhibit P-27, p. 5 (para. 3) and p. 6 (para. 4) and Transcript of September 14, 2010 at page 76-77), as well as information disclosed in prior art that had not yet formed part of what can be regarded as common general knowledge.

iv. *The '115 Patent*

[78] As mentioned, the number of claims in play in this patent was greatly reduced and the Court only needs to construe the independent claim 3.⁵⁸

[79] This claim reads as follows:

3. In a method of making a lithium mixed metal polyanion compound by reacting a mixture of a lithium compound and at least one metal containing compound, said compounds in particle form, the improvement comprising:
incorporating carbon into said mixture in an amount sufficient to reduce the oxidation state of at least one metal ion of the metal containing compound without full reduction to an elemental state and carrying out the reaction in the presence of said carbon.

[80] The '115 Patent is entitled *Preparation of lithium-containing materials*, the 63 page disclosure is followed by 140 claims. Considering the claim at issue here, the Court will focus in these reasons on the parts of the disclosure that were referred to by the parties and appear to be the

⁵⁸ See page 5 of the September 30th transcript and page 143 of the October 1st transcript. Obviously, the Court will still consider the other claims as part of the context in which claim 3 is to be read.

most relevant.⁵⁹ Also, because the '366 Patent and the '115 Patent share a common disclosure (with the exception of p. 20o to 20r), I will include some passages that may be more relevant to the '366 Patent. This will avoid having to refer to this disclosure again while construing the claims of the '366 Patent.

[81] Under “Field of the Invention” on page 1, one finds that the invention is to relate to “improved materials usable as electrode active materials and to their preparation.” In the “Background of the Invention”, the inventor describes in general terms the preparation of lithium batteries, the material used for the anode and the preferred positive electrode active materials which are said to “all have a common disadvantage in that the charge capacity of a cell comprising such cathodes suffers a significant loss in capacity” (page 2, line 32 to 34).

[82] In the “Summary of the Invention” on page 4, it becomes clear that the methods of the invention are useful in the preparation of materials of known products as well as novel compounds (see page 14). The desirable lithium mixed metal phosphate is represented by the nominal general formula $\text{Li}_a\text{MI}_b\text{MII}_c(\text{PO}_4)_d$. In one aspect MI and MII are the same, although in a preferred aspect they are different from one another. At least one of MI or MII is an element capable of an oxidation state higher than that initially present in the lithium-mixed metal phosphate compound (page 4, line 35 to page 5, line 2). The invention is said to apply to a variety of metals, for example MI is selected from: Fe (iron), Co (cobalt), Ni (nickel), Mn (manganese), Cu (copper), V (vanadium), Sn (tin), Ti (titanium), Cr (chromium), and mixtures thereof (page 5). Among other things, it is said that MI is preferably at the +2 oxidation state (page 6). The disclosure then goes on to discuss aspects where the structure of the product may differ due to variations of the product formula.

⁵⁹ For example, there is no need to discuss the novel compounds or compositions discussed in the disclosure.

[83] The inventor also indicates that the anode active material (negative electrode) also comprises “carbonaceous material such as graphite” (page 7).⁶⁰

[84] At page 7 of the disclosure, it is clear that in one embodiment:

The starting (precursor) materials include a lithium-containing compound, one or more metal containing compounds, a compound capable of providing the phosphate (PO_4)⁻³ anion, and carbon. Preferably, the lithium-containing compound is in particle form, and an example is lithium salt. Preferably, the phosphate-containing anion compound is in particle form, and examples include metal phosphate salt and diammonium hydrogen phosphate (DAHP) and ammonium dihydrogen phosphate (ADHP). The lithium compound, one or more metal compounds, and phosphate compound are included in a proportion which provides the stated nominal general formula. The starting materials are mixed together with carbon, which is included in an amount sufficient to reduce the metal ion of one or more of the metal-containing starting materials without full reduction to an elemental metal state. Excess quantities of carbon and one or more other starting materials (i.e., 5 to 10% excess) may be used to enhance product quality. A small amount of carbon, remaining after the reaction, functions as a conductive constituent in the ultimate electrode formulation. This is an advantage since such remaining carbon is very intimately mixed with the product active material. Accordingly, large quantities of excess carbon, on the order of 100% excess carbon are useable in the process. The carbon present during compound formation is thought to be intimately dispersed throughout the precursor and product. This provides many advantages, including the enhanced conductivity of the product. The presence of carbon particles in the starting materials is also thought to provide nucleation sites for the production of the product crystals.

(page 7, line 28 to page 8, line 23)

⁶⁰ As mentioned earlier, carbonaceous material is used not only in the anode but in the cathode when making the battery cell together with solvent such as EPS. This is obviously to be distinguished from the carbon referred to in the context of the synthesis of the active material referred to in this patent.

[85] The disclosure then goes on to discuss various aspects of this method which can be carried out in a single phase or in two phases with different precursors. Then at page 13, the inventor gives some more details about the preparation of the starting materials and how they are to be reacted:

Before reacting the compounds, the particles are intermingled to form an essentially homogeneous powder mixture of the precursors. In one aspect, the precursor powders are dry-mixed using a ball mill, such as zirconia media. Then the mixed powders are pressed into pellets. In another aspect, the precursor powders are mixed with a binder. The binder is selected so as to not inhibit reaction between particles of the powders. Therefore, preferred binders decompose or evaporate at a temperature less than the reaction temperature. Examples include mineral oils (i.e., glycerol, or C-18 hydrocarbon mineral oil) and polymers which decompose (carbonize) to form a carbon residue before the reaction starts, or which evaporate before the reaction starts. In still another aspect, intermingling is conducted by forming a wet mixture using a volatile solvent and then the intermingled particles are pressed together in pellet form to provide good grain-to-grain contact.

(page 13, line 19 to page 14, line 2; emphasis added)

[86] At page 14, one finds again that although one could use the precursor compounds in “a proportion which provides the stated general formula of the product,” the carbon may also be present at up to 100% excess compared to the stoichiometric amount required to do the reduction.

[87] At page 16 the inventor states:

it is desirable to conduct the reaction at a temperature where the lithium compound reacts before melting. The temperature should be about 400°C or greater, and desirably 450°C or greater, and preferably 500°C or greater, and generally will proceed at a faster rate at higher temperatures. The various reactions involve production of CO or CO₂ as an effluent gas.

[88] The inventor then goes on to explain how depending on the production of CO or CO₂, one will require more carbon if one wishes to use only the stoichiometric quantity required to reduce the metal to a certain valency.

[89] At page 17, one can read:

the method of the invention utilizes the reducing capabilities of carbon in a unique and controlled manner to produce desired products having structure and lithium content suitable for electrode active materials. The method of the invention makes it possible to produce products containing lithium, metal and oxygen in an economical and convenient process. The ability to lithiate precursors, and change the oxidation state of a metal without causing abstraction of oxygen from a precursor is heretofore unexpected. These advantages are at least in part achieved by the reductant, carbon, having an oxide whose free energy of formation becomes more negative as temperature increases.

[90] The method is said to utilize “an effective combination of quantity of carbon, time and temperature to produce new products and to produce known products in a new way” (page 18, line 4 to 7). Various details as to the gases produced at different temperatures and as to the temperature ramp rate during the reaction are then discussed before specifying that “[t]he heating is preferably conducted under non-oxidizing or inert gas such as argon or vacuum. Advantageously, a reducing atmosphere is not required, although it may be used if desired” (page 18, line 35 to page 19, line 2; emphasis added).

[91] According to the inventor, the invention resolves the capacity problem caused by the widely used cathode materials in improving the said capacity in a relatively economical and readily adaptable method for commercial production, particularly for the preparation of large quantities.

[92] Then at page 20, the inventor discusses another embodiment of the method of the invention which comprises:

a method of making a lithium mixed metal polyanion compound by reacting a mixture of a lithium compound and at least one metal containing compound, said compounds in particle form, the improvement comprising of an incorporating carbon into said mixture in an amount sufficient to reduce the oxidation state of at least one metal ion of the metal containing compound without full reduction to an elemental state and carrying out the reaction in the presence of said carbon.

This embodiment is described in terms similar if not identical to those found in claim 3.

[93] The additional pages (20a to 20n)⁶¹ added at some point before the issuance of the patent describe further embodiments or aspects of the methods of the invention, some are more precise in terms of the precursor materials to use while others involve different stages where the carbon is sometimes described as part of the starting materials and sometimes is simply said to be incorporated into the starting materials described therein. Sometimes this incorporation is prior to heating (page 20a, line 10) and sometimes it is simply before carrying out the reaction (page 20i, line 32).

[94] A particularly preferred embodiment is where the compositions described use carbon in excess desirably up to 100% stoichiometric excess (page 20i, line 9 to 13).

[95] At page 20j, the inventor describes an embodiment where the starting materials desirably include carbon, in powder form, and the reaction involves reacting “a finely divided mixture” of the reactants.

⁶¹ The Patent Office accepted that these amendments could all be reasonably inferred from the information in the original disclosure. See s. 38.2. This decision was not challenged.

[96] At pages 20o to 20r (which are only present in the '366 Patent), various aspects of the invention include mixing the starting materials in particle form with a volatile solvent or binder, where the starting materials include carbon. Additionally, these pages describe various compositions made through a process whereby the precursor compounds are mixed with a volatile solvent or binder and reacted in the presence of carbon.

[97] It is not clear to me that amendments made well after the publication date are to be considered in construing the patent given that these amendments would not be available at the date of publication. The parties did not raise or argue this point and I need not decide it in this case for I am satisfied that the construction I have adopted (in respect of the '115 and '366 Patent claims) would be the same whether I consider the disclosure as originally published or as amended.

[98] The disclosure then gives a brief description of the 23 figures found at the end of the patent, the first three refer to LiFePO_4 which is the material at issue in these proceedings. That final compound is specifically referred to many times in the disclosure.

[99] At page 27, one finds a detailed description of the preferred embodiments which goes into the specifics of the construction of the positive electrode and the lithium iron battery.⁶²

[100] It is followed by a series of ten examples. The first three examples relate to the reaction of LiFePO_4 using materials (including carbon) for which few details are given. Examples 4 to 10 relate

⁶² One finds a reference to the word "binder" on page 35 with respect to the negative electrode.

to other compounds covered by the nominal formula referred to earlier. Again the carbon used is not described in detail except in example 9 where it is specified to be “Shiwinigan Black” (*sic*).⁶³

[101] From page 45 to 60, the inventor discusses the “Characterization of Active Materials and Formation and Testing of Cells”.

[102] At page 60, the inventor states that “[t]he reduction capability of carbon over a broad temperature range is selectively applied along with thermodynamic and kinetic considerations to provide an energy-efficient, economical and convenient process to produce compounds of a desired composition and structure. This is in contrast to known methods.” Then at line 16, one finds a passage that was the subject of much discussion during the trial, it reads as follows:

Principles of carbothermal reduction have been applied to produce pure metal from metal oxides by removal of oxygen. See, for example, U.S. Patent Nos. 2,580,878, 2,570,232, 4,177,060, and 5,803,974. Principles of carbothermal and thermal reduction have also been used to form carbides. See, for example, U.S. Patent Nos. 3,865,745 and 5,384,291; and non-oxide ceramics (see U.S. Patent No. 5,607,297) . Such methods are not known to have been applied to form lithiated products or to form products without oxygen abstraction from the precursor. The methods described with respect to the present invention provide high quality products which are prepared from precursors which are lithiated during the reaction without oxygen abstraction. This is a surprising result.

[103] Then on page 61:

The convenience and energy efficiency of the present process can also be contrasted to known methods for forming products under reducing atmosphere such as H₂ which is difficult to control, and from complex and expensive precursors.^[64] In the present invention,

⁶³ Details of the example are found in a table on slide 9 of Exhibit P-27A.

⁶⁴ Phostech argued that this means that it was commonly known to make lithiated products using a hydrogen atmosphere to reduce the metal. No expert commented on this section and given the absence of evidence that it was

carbon is the reducing agent, and simple, inexpensive and even naturally occurring precursors are useable. For example, it is possible to produce LiFePO_4 from Fe_2O_3 , a simple common oxide.

[104] The parties are agreed that all the elements mentioned in independent claim 3 whatever their meanings are essential. The Court agrees.

[105] In their agreed list of issues, the parties included the meaning of the word “carbon” and of the expression “incorporating carbon into said mixture”.

[106] Also, even though this was not in the agreed list of issues and was only made clear during the final arguments,⁶⁵ Phostech argues that considering the amount of carbon to be included – in Phostech’s view a stoichiometric quantity – and the requirement that the reaction be carried out in the presence of such carbon, it is also an essential element of the claim that carbon be the only reducing agent used in the process.

[107] From my review of the disclosure and all the claims, it appears that the invention set out in the ‘115 Patent can be summarized as: an improved method where selective CTR is used to make lithium mixed metal compounds (such as LiFePO_4) that could contain conductive carbons intimately mixed in the final product of the reaction. Thus, a feature of the invention is that carbon can have a dual role – enabling the use of cheaper metal-containing compounds with a valency that will be reduced by CTR and increasing the conductivity of the end product.

known to use hydrogen gas to reduce a metal in lithiated products as opposed to providing a non-oxidizing atmosphere that prevents impurities, the Court does not accept this argument.

[108] The particular monopoly claimed in claim 3 relates more specifically to the use of carbon or CTR to make a “lithium mixed metal polyanion”.

[109] Here, “polyanion” will be understood in its usual and customary meaning requiring at least two anion species, that is, multiple elements and an overall negative charge such as in phosphate $(\text{PO}_4)^{3-}$.

[110] It is agreed that the requirement for the precursors or starting materials to be in “particle form” means that the lithium and the transition metal(s) containing compound can be in various forms such as crystals, granules or powders and that the posita would understand that they need to be sufficiently small to permit them to be reactive.

[111] Turning now to the issues in dispute. Dr. Whittingham opined that the word “carbon” means carbon in particulate form or particles of carbon. He notes that “carbon” must necessarily refer to solid carbon and that the form customarily used in the industry in making lithium batteries was carbon black powder. He thus assumes that this was what the inventor had in mind particularly in light of example 9, which uses Shawinigan Black. However, Dr. Whittingham appears to agree although reluctantly⁶⁶ that the reference to a binder that would “carbonize” at page 13 implies that the residue which includes carbon would be in particulate form. Still, according to him, it would be excluded from the claim unless it was added in that form to the mixture of starting materials. For all

⁶⁵ In fact Phostech had advised the Court earlier in the process that it was not contesting that the wording of claim 3 did not preclude the use of a reducing atmosphere (not an essential element).

practical purposes, except for the fact that claim 3 covers only polyanion compounds, Dr. Whittingham construed independent claim 3 exactly like independent claim 1 which expressly provides that carbon in particle form must be a starting material.

[112] Dr. Whittingham also opines that the posita would read claim 3 as requiring that the carbon be added in the exact amount required to reduce one of the transition metals, that is, in a stoichiometric proportion.

[113] For Valence, “carbon” is not restricted to a form where it is elemental or pure carbon for there is no specification as to the source or provenance of the carbon in the claim. The claim only requires that the reduction take place in the presence of this carbon. For Dr. Cairns, it is clear that “carbon” would be construed by a posita to include not only carbon black powder but also, among other things,⁶⁷ the carbon in the residue referred to in page 13 of the disclosure which results from the pyrolysis of binders such as hydrocarbon mineral oil and polymers which are expressly said to “carbonize”. Drs. Dahn and Morgan share this view.

[114] Dr. Dahn⁶⁸ testified that “incorporating carbon into said mixture” only means to a posita that you have to add carbon to the reaction mixture to perform the necessary reduction and it really doesn’t matter how the reducing carbon gets in there. It could be done directly in the form in which it will react or via a precursor material such as a binder (including a polymer) which would yield carbon in a form that can be used in the CTR. Dr. Dahn contrasts the wording of claims 2 and 3, for

⁶⁶ See Transcript of September 13th, 2010 at p. 150, lines 13 to 20.

⁶⁷ Dr. Cairns noted that it could include “tar” where the carbon is clearly not in particulate form.

⁶⁸ It is worth mentioning that Dr. Dahn’s evidence in respect of the construction of the Valence patents was not challenged during his cross-examination.

example, where in claim 2 the carbon is mixed in the starting material in particle form whereas in claim 3, the language indicates that it could be added in any way possible, not only in particle form. Dr. Cairns and Morgan again supported this interpretation.

[115] It is not disputed that the posita would understand that in carrying out the selective CTR the “carbon” must be intimately mixed with the starting material before the reduction starts and he or she would know that the carbon, whether included in particle form before the mixture was heated or in particle form before the reduction starts as a result of the decomposition of a polymer, would be equally capable of carrying out the CTR.

[116] The Court notes that independent claim 108 covers a composition prepared by the process described in very similar words as claim 3. Claim 109 (dependent on claim 108) is restricted to a composition prepared by the process where carbon in powder form is used implying that “carbon” in independent claim 108 comprises more than that form.

[117] The explanation given by Phostech’s counsel to justify interpreting the different language used in claim 1 versus claim 3 or claim 25 versus claim 26 is not convincing. Although it is evident that these claims cover embodiments, that can be distinguished on other grounds, this in and of itself does not explain why the inventor chose such different wording to describe the carbon and how it is used in the process.

[118] The Court notes that Dr. Whittingham appears to have used his knowledge and understanding of the ‘366 and ‘918 Patents to confirm or come to his understanding of claim 3 (and

later his view on claim 26 which will be discussed below in the '366 Patent).⁶⁹ One cannot use external sources of this kind to construe a patent. Also Dr. Whittingham reluctantly admitted in cross-examination that in the end, the posita would understand that “carbon” referred to in claim 3 must be in a form where it is capable of performing CTR.⁷⁰

[119] “Carbon” is a wide term. The fact that carbon black in powder form is what first comes to mind because it is used in making cathode cells or because it is used in example 9 and appears to be one of the preferred forms is not sufficient to justify limiting the claim in the manner proposed by Dr. Whittingham, especially when it is clear and was known that it makes no difference to the carbon’s ability to reduce in CTR.⁷¹ Having considered the expression in its entire context, the Court prefers the construction proposed by Drs. Cairns, Dahn and Morgan

[120] This leaves only one issue: whether or not claim 3 requires as one of its essential elements that carbon be the sole reductant used in the process.

[121] It is evident, in my view, that, in fact, this claim only refers to the minimum amount of carbon that should be incorporated prior to carrying out the reduction. One only needs to consider the dependent claims 52 and 53 which necessarily cover embodiments included in claim 3 in order to conclude that the interpretation proposed by Dr. Whittingham is not tenable in this particular

⁶⁹ See e.g. Transcript of September 10th, 2010 at p. 121-122.

⁷⁰ See Transcript of September 13th, 2010, p. 149, line 25 to p. 150, line 11.

⁷¹ There is no evidence that this would change the process described in para 12 above.

context. In effect, those dependent claims refer to processes where the carbon added is in excess of the stoichiometric amount by as much as 100%.

[122] It is not disputed that the only reductant claimed is carbon. However, the claim as drafted only describes it in the portion which follows the introductory comment “the improvement comprising:” along with the features that are new. This signals that there may be other non-essential elements used in conjunction with the essential elements of the method claimed.⁷² For example, there is no mention of the gaseous atmosphere the posita would be expected to use in carrying out the CTR. All the experts agreed that as mentioned in the disclosure (para. 90 above), a posita would normally use a non-oxidizing atmosphere. This includes an inert gas, vacuum or a reducing atmosphere (more expensive and sometimes more difficult to control) although the use of the latter is not necessary, it is clearly acknowledged that one may still choose to use it.

[123] I am also satisfied that the posita would know that some gases will be produced when the binder or solvent referred to on page 13 of the ‘115 Patent either evaporates or carbonizes.⁷³ Also, the posita would know that if one uses a hydrated compound as a starting material, such as a dihydrated phosphate, water would evaporate to produce H₂O gas.

[124] The Court accepts Dr. Dahn’s evidence that CTR itself generates gases (such as CO) that will contribute to the reduction reaction. In fact the disclosure itself indicates that depending on the

⁷² This is also in line with the principle that variants in respect of non-essential elements will not necessarily avoid infringement.

⁷³ That is not to say that the posita would commonly know exactly what gases would be produced but he would certainly know about some of them simply by looking at the composition of the binder or solvent.

temperature of the reaction, different gases will be produced such as CO, CO₂ or a combination thereof.⁷⁴

[125] All this to say that the posita could expect that by using certain embodiments covered by claim 3, some gases, including in certain cases a reducing atmosphere used as a non-oxidizing environment, may well contribute to the reduction of metal ions in the metal-containing compound even when one uses the CTR method described in claim 3.

[126] Obviously, this does not mean that claim 3 would cover a method where one used a reducing atmosphere or another reducing agent to reduce all or most of the metal ions in the metal compound before the CTR process described in claim 3 can occur. For example, if one were to use a reducing atmosphere of hydrogen in conditions (time, temperature, quantity) where it is clear that the hydrogen will reduce the valency of the metal-containing compound well before the claimed process can take place.

[127] There are also many variants between those extremes that could occur. The Court is not willing to venture as to where one should draw the line considering that the evidentiary record before me is neither adequate nor sufficient to do so. Had Phostech made its position clear before the closing of evidence, especially when the Court expressly sought clarification in this respect, the Court would have insisted on obtaining better evidence from the experts. As the matter stands now, more precise interpretation of claim 3 is better left to another day when the expert evidence deals with this issue in a more satisfactory manner.

⁷⁴ See Exhibit V-7, at para. 5.

[128] Based on the foregoing and considering the expert evidence before me, the Court concludes that it is not an essential element of claim 3 that each and every ion of the metal-containing compound be reduced by the carbon described in the claim.

v. *The '366 Patent*

[129] As mentioned, the '366 has the same disclosure as the '115, with the exception of the additional pages 20o to 20r. It ends with 82 claims.

[130] The only independent claim to be construed is claim 26. It reads as:

A method for the synthesis of a Li metal compound of the formula



wherein the lithium of the metal compound is linked by being nucleated or bound to carbon, a is greater than 0 but less than or equal to 3, and y is greater or equal to 0 and less than or equal to 1, d is greater than 0 and less than or equal to 3, X is P, S or Si, MI is a transition metal or a mixture of transition metals selected from the group consisting of Fe, Co, Ni, Mn, Cu, V, Ti, and Cr, and MII is an element with fixed valency selected from the group consisting of Mg, Ca, Zn, Sr, Pb, Cd, Sn, Ba, Be, and mixtures thereof, by bringing into equilibrium for a thermal synthesis, a mixture containing at least one precursor of

- a) a source of the element MI, at least part of said transition metal or metals that constitute MI being in an oxidation state greater than that of the metal in the compound of the above formula;
 - b) a source of the element MII;
 - c) a compound that is a source of the element lithium;
 - d) a compound that is a source of the element XO_4 if the element X is not present in another compound or source;
 - e) a source of carbon,
- said at least one precursor of said sources (a) to (d) being present in the mixture in proportions required to form the lithium metal compound, and said at least one precursor having one or more additional elements other than the elements of (a) to (d),
- said method comprising effecting the thermal synthesis reaction between said at least one precursor of said mixture in a gaseous atmosphere to reduce the valency of the transition metal or

metals to a desired valency and including the step of controlling the composition of the gaseous atmosphere, the temperature of the reaction and the relative amount of the source of lithium proportionately to the sources of (a), (b) and (d),

said method comprising at least one thermal step to heat said source of carbon and to decompose or transform the same, and to obtain said mixed metal compound having electrical conductivity.

[131] There is no disagreement that except for MII, each stated element is essential. There is a dispute as to the meaning of the words “source of carbon” and “additional elements” and as to what is the reducing agent in the asserted claim.

[132] Other issues relating to construction raised by Dr. Whittingham in his initial report⁷⁵ such as those relating the expressions “mixed metal compound having electrical conductivity” and “decompose or transform” were abandoned by Phostech before the end of the oral arguments.

[133] Dr. Whittingham opines that “a source of carbon” would normally be construed as carbon itself or a compound containing carbon. However, given that sub-paragraph (e) does not include the words “a compound that is a source of” as in sub-paragraph (c) and (d) of the claim, it is to be limited to carbon itself and not to a compound containing carbon. According to Phostech’s expert, the specification and the examples do not support any other construction.

[134] This is disputed by Valence whose experts stated that the posita would understand that this is referring to carbon itself or any carbon-containing material such as those that can yield carbon in a form that can achieve the CTR. In reaching this conclusion, they considered among other things the other portion of the claim which refers to “one thermal step to heat said source of carbon and to

⁷⁵ Part of the exceedingly literal and grammatical approach taken by Dr. Whittingham.

decompose or transform the same”. Although the term “source of” is not used *per se* in the disclosure, this step would be understood as including what is described on page 13 of the specification (*i.e.* a binder that decomposes to form a carbon residue). Here again, Valence experts do not construe this expression as being limited to carbon in a particle form.

[135] In respect of the “thermal step” referred to above, Dr. Whittingham agreed that this would be understood as a step which would heat the “source of carbon” causing it to change its chemical composition (decompose) or transform. Dr. Whittingham also acknowledged that there is support (albeit this is the only instance) for a source other than carbon itself at page 13 of the specification.

[136] According to Dr. Dahn, this thermal step is to enable the carbon to reduce the metal and to make the reaction product (final compound) conductive. This is disputed by Dr. Whittingham who understands that this source of carbon will only be used as residual carbon in the final product. His view is based on the description of embodiments found on pages 20o to 20r of the disclosure where the process described includes the use of a binder or volatile solvent as well as carbon in particle form.

[137] With respect to the “additional element”, there is no dispute that this refers to an element that participates in the overall reaction, but does not become part of the final product because of the formula referred to at the beginning of claim 26. According to Dr. Cairns, this emphasizes the point that one uses a compound as opposed to pure elements.⁷⁶ This requires the inclusion of one element of the periodic table that is not MI, MII, Li, XO₄ to be present in one of the precursor materials

⁷⁶ However, Dr. Cairns did acknowledge that he did not fully understand why the inventor included such a limitation in his claim (Transcript of September 14, 2010 at p. 196-197).

described in sub paragraph (a) to (d) of the claim. An example of this would be when the source of lithium (c) is lithium carbonate. Carbon and oxygen in the lithium carbonate would be “additional elements”. For Dr. Cairns, this “additional element” could be carbon that could function as a reducing agent but it is not necessarily so in all embodiments covered. All are agreed that the meaning of this term would be the same in all claims (such as claim 1).⁷⁷

[138] Dr. Whittingham’s opinion that this expression necessarily refers to carbon is based on his view that there is no other information about this additional element in the disclosure. He also notes that in claim 1 the additional element must be carbon for there would be no other reductant listed in that claim apart from the reducing atmosphere. It would thus appear to be wider than the invention for it would not involve CTR. However, Phostech acknowledged that whether or not a claim should fail for insufficiency or because it is broader than the invention is not relevant at this stage, the Court must construe the claim without regard to its validity.

[139] The Court finds that the interpretation of “source of carbon” proposed by Valence’s experts is more in line with the context in which one must read claim 26 particularly having regard to the structure of the claims that follow. In effect, although as a whole the claims are not particularly well written and one can detect many overlaps if not redundancies, the Court cannot simply ignore them as Dr. Whittingham appears to have done.

⁷⁷ Valence acknowledged during the final arguments that claim 1 of the ‘366 Patent had “problems” and that this was one of the reasons why it was not put in play in these proceedings. Certainly, Dr. Dahn construed claim 1 as not necessarily requiring the presence of carbon. The reduction of the metal containing compound could be done entirely by the reducing atmosphere included as one of the essential elements of the claim. This obviously raises an issue as to whether claim 1 is broader than the invention.

[140] In this case, claims 33 to 36, which are all dependent on claim 26, each cover specific type of sources of carbon such as:

- a. The source of carbon is carbon or a precursor thereof (claim 33);
- b. The source of carbon comprises a polymer (claim 36);
- c. The source of carbon contains a source of oxygen and hydrogen which are chemically bound (claim 34);
- d. The source of carbon is a polymer or mineral oil which is capable of degradation at the stated temperature (claim 35).

[141] As one can appreciate, in this context, to construe the source of carbon as referring exclusively to solid carbon, as proposed by Dr. Whittingham, makes little sense.

[142] As to the “additional elements”, the Court again prefers the interpretation proposed by Dr. Cairns as it is more in line with the wording of the claim itself which does not appear to contain any ambiguity⁷⁸ unless one considers issues of invalidity such as insufficiency or overbreadth.

[143] The “gaseous atmosphere” refers a non oxidizing atmosphere that can include, as dependent claim 29 illustrates, a reducing or neutral atmosphere. The reducing atmosphere may include CO (claim 42), CO in the presence of a neutral gas (claim 44) or CO mixed with CO₂ (claim 46). Furthermore, as mentioned in claim 49, the reducing atmosphere may be obtained by the thermal

⁷⁸ Dr. Dahn and Phostech’s representative, Dr. Michel Gauthier, appear to have had no difficulty identifying this element which was admitted to be included in Phostech P1 process (See Exhibit V-5, Tab T, p. 6 and Trial Record, Tab 5, p. 48 and Tab 6, p. 3).

decomposition of the source of carbon which generates CO, or a mixture of CO/CO₂ with water vapour.

[144] As mentioned earlier, the Court is satisfied that the posita would understand that some of these gases may evolve from either the decomposition of certain binders or volatile solvents mentioned on page 13 of the patent or the CTR reaction.

[145] In this context, the Court finds that the reducing agent(s) in the '366 Patent, particularly claim 26, include the source of carbon and the reducing atmosphere which may comprise gases evolving from the decomposition of the source of carbon or during CTR and externally applied gases such as CO/CO₂ with or without neutral gases.

[146] Finally, the Court finds that the expression “linked by being nucleated or bound to carbon” would be understood by a posita, not as referring to only the formal molecular bond between the lithium and carbon proposed by Dr. Whittingham, but rather, as explained by Dr. Morgan and Dr. Dahn, to the fact that the lithium iron phosphate would be intimately associated or attached to the carbon. The word “nucleated” is qualified by the words “linked” and “bound” and the fact that the inventor on page 8, lines 22 to 23 of the disclosure was only formulating a hypothesis

(“thought”).⁷⁹ As explained by Dr. Dahn, the coating referred to in claim 31 is only one such type of attachment or bond.

vi. The ‘918 Patent

a. Common General Knowledge for the ‘918 Patent

[147] In addition to the common general knowledge described above in respect of the ‘115 and ‘366 Patent, the Court is satisfied that what is generally disclosed in the ‘119 Patent and the series of articles published before 2003 in relation thereto was part of general knowledge on or before December 2003.

[148] As mentioned by Dr. Cairns, I also accept that a posita would have known that most of the polymers decompose below 400°C by that date.

[149] There is insufficient evidence for the Court to conclude that the content of the original application for the ‘115 Patent, although clearly part of prior art published at the time had become part of the common general knowledge.

b. The patent

[150] The ‘918 Patent is entitled “Synthesis of Metal Compounds Useful as Cathode Active Materials” and its 57-page disclosure ends with 12 claims. The parties are agreed that the Court only needs to construe claim 1 which is the only independent claim in this patent. It reads as follows:

⁷⁹ The relevant evidence can be found at Exhibit V-24 at paras 85-90, Exhibit V-20 at para 82-83, Exhibit V-8, slide 15 and Transcript of September 2nd, 2010 at p 132, line 18 to p 135, line 11. See also Exhibit P-27, Appendix C at p. 18-19. The Court will discuss the relevant evidence found in Dr. Bale’s Reports (Exhibits P-6 & P-7) later on.

1. A solid state method for synthesizing an inorganic metal compound, comprising the steps of:
 - combining starting materials comprising at least one particulate metal compound and at least one organic material to form a mixture; and
 - heating the mixture at a temperature to form a reaction product, wherein upon heating, the at least one organic material decomposes to form a decomposition product containing carbon in a form capable of acting as a reductant,
 - wherein at least one metal of the starting materials is reduced in oxidation state during heating to form the inorganic metal compound.

[151] There is no dispute as to the meaning of this claim or the invention described in the patent.

The parties have also agreed and so does the Court that all the elements of Claim 1 are essential.

Although the Court has clearly gone through the disclosure very carefully, in light of the above, it is not useful to discuss the disclosure in these reasons. It is also worth mentioning that the language indicates that carbon need only be a reductant (see paras 12 and 18 of the disclosure), which does not preclude the use of a gaseous atmosphere that participates in the reduction.⁸⁰

[152] Claim 1 covers a wider variety of precursor materials (including organic compounds) and a wider range of materials produced by the synthesis. For example, there is no requirement that such products include lithium or PO₄.

2. Infringement

[153] It is not disputed that Valence has the burden of proof and that it must establish on a balance

⁸⁰ Although originally disputed by Phostech, this was no longer in dispute by the end of the trial: Transcript of September 29, 2010 at p. 107-108; Transcript of September 14, 2010 at p. 56.

of probability that the process used by Phostech includes all the essential elements of at least one claim in the patent at issue.

[154] Since the beginning of these proceedings, Phostech's position has been that its process does not involve any CTR. Also, that there is no "carbon" (in particle form) in its starting materials or incorporated into them. Thus, there can be no infringement of the '115 Patent.

[155] It has been established that the starting materials of the P1 Process are pellets of fine particles⁸¹ of lithium carbonate (Li_2CO_3) and a ferric phosphate ($\text{FePO}_4 \cdot 2\text{H}_2\text{O}$) mixed and coated with a polymer – a binder that carbonizes at a temperature below 400°C leaving a carbon residue mixed into the aforementioned starting materials before the reaction is carried out in the presence of such carbon.

[156] Dr. Dahn calculated the amount of carbon which should be present in the residue left at the end of the polymer decomposition (pyrolysis or carbonization) and was satisfied that there was enough to reduce the iron in the ferric phosphate used in the P1 Process from Fe^{3+} to Fe^{2+} . This is not contested.

[157] There is no dispute that the Phostech final product contains between 1% to 2% residual carbon.

⁸¹ The particles are very small so that there are literally millions of them in each pellet (see Annex A).

[158] In light of the construction adopted by the Court, on its face, the P1 Process includes all the essential elements expressly referred to in claim 3 of the '115 Patent.

[159] However as mentioned, Phostech nevertheless claims that it does not use the invention because the carbon it uses does not act as a reductant in its process.⁸²

[160] There is little doubt that at the temperatures used in the P1 Process a very significant portion of which is carried out at 700 °C (see Annex A) the carbon present can reduce the iron to a +2 valency through CTR. As mentioned, what Dr. Bale's evidence purports to establish is that by the time CTR can occur all the iron has already all been reduced by the gases/vapours produced during the decomposition (carbonization) of the polymer.

[161] One of the key elements of Dr. Bale's theory, on which he insisted at the trial, is that carbon cannot reduce iron at temperatures lower than 600 °C and certainly not between 400 and 500 °C.

[162] As will be discussed, Dr. Dahn disagrees with Dr. Bale. He concluded that although it is possible (not established as a fact in this case) that a very minor fraction of the iron ion is reduced by the gases evolving from the decomposition of the polymer,⁸³ the reduction of the iron in the synthesis of Phostech's C-LiFePO₄ is done through CTR. Carbon (including the effluent gases it produces) is the reducing agent.⁸⁴

⁸² What is contested is that it effectively does the reduction.

⁸³ Exhibit V-5 at paras 38-39; Exhibit V-7 at para 5; Transcript of September 14, 2010 at p. 156.

⁸⁴ Exhibit V-5 at para 154; Exhibit V-7 at para 5.

[163] It is not disputed that one cannot directly measure what actually happens in the closed kiln used by Phostech. Also the temperatures are maintained through external means and it is allegedly not possible to actually measure the temperature of the pellets moving through the kiln. Thus, both experts performed, or had performed under their directions, various experiments to simulate the reactions in the P1 Process. It is not disputed that these experiments were carried out in a professional manner and in accordance with the state of the art.⁸⁵ The difference of opinion between these experts is mainly based on their interpretation of the results of the various tests performed and what they reveal about what really occurs in the P1 Process.

[164] Dr. Bale acknowledged that there are two main areas where he and Dr. Dahn disagree:

- a. At what temperature the reduction takes place in the P1 Process;
- b. How long the vapours or gases evolving from the decomposition of the polymer would be in contact with the other materials inside Phostech's pellets in the P1 Process.

[165] In the final arguments, among other things, Phostech's counsel put forth six reasons why the Court should give more weight to Dr. Bale's evidence than to that of Dr. Dahn. They are as follows:

- a. Dr. Bale used a greater number of experimental techniques to analyze the reactions taking place in the P1 Process;
- b. The explanations given by Dr. Bale of the TGA results of the P1 Process conform with all his previous TGA results. In that respect, Dr. Bale performed four sets of

⁸⁵ Although the relevance of the parameters used is sometimes disputed like the size of particles, the rate of the gas flow, the position of the reactants vis-à-vis the gases *etc.*

tests (polymer alone, lithium carbonate and ferric phosphate dihydrate alone, lithium carbonate and ferric phosphate dihydrate with carbon black, and the P1 precursor materials including the polymer). On the other hand, Dr. Dahn's mainly focused on the results of the last type of test (P1 precursor materials) and his hypothesis that the carbon in such case is in a less stable form and is in more intimate contact with the precursors, which will lower the reaction temperature (CTR);

- c. Dr. Bale individually tested both reductants present in the P1 Process, i.e. the polymer vapours acting alone (the so called Vapour Test at 400°C for 120 minutes) and carbon black powder (mixture of graphite and amorphous carbon);
- d. In performing his TGA experiments, Dr. Dahn admitted that the rate of the flow of inert gas he used was faster than the actual rate used in the Phostech kiln.⁸⁶ This swept away the gases formed from polymer decomposition faster than in the Phostech kiln;⁸⁷
- e. Dr. Bale performed additional XRD testing demonstrating the complete formation of LiFePO_4 at 400°C after two hours;
- f. The Court should not give any weight to the difference in carbon content of the samples tested by Dr. Dahn as this is not conclusive evidence of CTR given that there are other carbon atoms in the system (for example when the lithium carbonate reacts).

⁸⁶ Whereas in Dr. Bale's Vapour Test, there is a cover that keeps the gases in contact with the precursor materials longer than in the P1 process and the vapours freely go to the precursor materials as the decomposing polymer is positioned directly under said materials.

⁸⁷ Although the Court notes that in Exhibit P-7 at p. 7, Dr. Bale acknowledges that in TGA experiments, presumably this would include his own TGA tests, gaseous by-products of the reaction are flushed out more rapidly than in the actual P1 Process.

[166] Nobody present at the trial will be surprised when I say that Dr. Bale's testimony was confused and somewhat confusing in many aspects. That said, the Court has reviewed very carefully all his evidence and that of Dr. Dahn, particularly keeping in mind the six points listed above. In the end, the Court found that Valence has met its burden of persuading the Court on a balance of probabilities that the iron in the Phostech P1 Process is reduced by CTR.

[167] Despite the highly commendable efforts of Phostech's counsel, neither their cross-examination of Dr. Dahn nor any of the six points referred to above seriously affected his credibility and the weight given to his opinion. In reaching his final opinion, Dr. Dahn clearly considered all of the experiments performed, including the results of the tests performed by Phostech's own technical director. Dr. Dahn is an expert with impeccable credentials in the lithium battery field who understood that his role was to advise the Court not to defend parties' particular position. He clearly felt confident that he had enough information to come to a scientifically sound conclusion. He addressed the matter with a level-headed approach in line with what the Court is accustomed to with technical experts. This is to be contrasted with Dr. Bale's conclusion, for example, in Exhibit P-7 at page 31 where he says that he could "state without any element of doubt that the Phostech P-1 process is NOT a carbothermal reduction process..."⁸⁸ I have rarely encountered a scientist willing to use such a high standard when the actual issue in dispute could not be tested directly. That said, it may well be that this was simply the result of too much "enthusiasm" coupled with a lack of

⁸⁸ The remark goes on to state: "e.g. solid carbon is not a reducing agent..." Because of the use of these terms the Court attempted to clarify if the parties had diverging views as to what constitutes CTR given that in the patent it is clear that the inventor includes reference to effluent gases like CO and CO₂, which are produced when carbon is heated. When assured that there was no such dispute, the Court took it that Dr. Bale understood carbothermal reduction in the same manner as Dr. Dahn described it in paragraph 5 of Exhibit V-7.

experience in appearing as an expert in Court proceedings. I have no doubt that Dr. Bale is a fabulous professor much appreciated by his students as demonstrated by his teaching award.

[168] Phostech argued that Dr. Dahn should have done more tests; that may well be so. But what surprises me most is the fact that Phostech's expert did not perform tests that more closely mirror the actual timing and temperatures used in its P1 Process.

[169] Dr. Dahn based his original tests on the parameters given to Valence during Phostech's examination for discovery.⁸⁹ For example, the length of the process (the pellets' residence time in the kiln) given to Dr. Dahn at the time was double what in fact was described by Mr. Geoffroy.⁹⁰ Dr. Bale appears to have had the correct residence time for his earliest report in May 2010, but Dr. Dahn was not informed of the correct details until his report in August 2010. Dr. Bale should have known better. It would certainly have been more relevant and useful for the Court to know if the gases, which according to Dr. Bale undeniably fully reduced all the iron, could effectively do so in circumstances more proportionally related to what takes place in the P1 Process. Why was the Vapour Test performed at 400°C for 2 hours, when one knows that the pellets in the P1 Process do not spend any appreciable time at that temperature? For example, why were these gases not tested for half an hour at temperatures ranging between 350 and 500°C?

[170] Like Dr. Dahn, the Court finds that Dr. Bale's Vapour Test establishes little other than the fact that the gases produced by the polymer decomposition can, in the unique circumstances of the experiment, reduce iron. This may well raise the possibility that in the P1 Process, they can also be

⁸⁹ Exhibit V-5, paras 128-134 citing the May 2009 Discovery of Dr. Michel Gauthier (Exhibit V-5, Tab I).

⁹⁰ Valence was advised on or about June 1, 2010 of this change (Exhibit V-6, Tab A).

active, but it is no more than a mere possibility. Dr. Dahn readily admitted that a small fraction of the metal ion might be reduced by these gases.

[171] At the trial, Dr. Bale relied heavily on the fact that carbon could not reduce or play any significant role below 600°C. Dr. Bale based that conclusion principally on the Ellingham Diagram that dates back to 1944 as well as his tests using carbon black powder. However, he admitted in cross-examination that the diagram⁹¹ was not truly relevant to the P1 Process except with respect to hydrogen. The most important reason for that in my view is that it does not truly reflect the reduction of phosphates (*e.g.* FePO₄) in a complex environment involving various kinetic properties that are not represented in the diagram.

[172] The Court accepts Dr. Dahn's evidence that when a less stable form of carbon than perfect graphite is used, this will have an impact on the temperature at which the reduction takes place. The more disordered and defective the carbon structure, the less stable it will be and it will begin to react with species like oxygen at lower temperatures. The carbon in the residue left in this case is an example of a disordered and less stable form of carbon. Furthermore, as it was admitted by Dr. Bale, a catalyst can lower the temperature at which carbon will begin to react in the carbothermal reduction process. Even the size of the reactants impacts on the temperature at which the reactions involved in the synthesis will take place, as was readily demonstrated by the differences in the result of tests performed by Canmet ENERGY – one set with bigger particle size (Exhibit V-5, Tab O), another with smaller particles (Exhibit V-7, Tab A).

⁹¹ Transcript of September 8, 2010 at p 184-185; see also Exhibit P-6 at p 16-17.

[173] Dr. Bale's theory as to which gases were the effective reductants in the P1 Process appears to have evolved between the time he filed his reports and the time he testified. It is not disputed that the first time that Valence heard about his views that hydrogen is the main reductant was at the trial itself. Dr. Bale said that the free radicals that are produced as a result of the pyrolysis of the polymer play an important role in the P1 Process although he could not really pinpoint that role and even the author of one of the articles he referred to (Exhibit P-7, Tab A, p. 31 and 47) recognized the mechanisms for radical formation are, indeed, complex and difficult to predict. The difficulty in identifying all the components of the vapour produced during the pyrolysis (carbonization) may explain Dr. Bale's evolving theory.

[174] Certainly Dr. Bale acknowledged that in the '115 Patent, it is clearly stated that CTR can reduce the metal in the process described therein at temperatures starting at 400°C. This particular statement was not challenged by Phostech in its counterclaim or its defence based on the alleged invalidity of the '115 or '366 Patent. Furthermore, when Phostech was asked during one of the examinations by Valence's counsel, whether it was aware of any publications by someone other than those involved in the present litigation or with the '129 Application, confirming that the carbothermal process could not work to reduce phosphate at 400°C, the answer was no.⁹²

[175] In the kiln, the pellets continuously move from left to right while the controlled atmosphere (gas flow) moves in the opposite direction. Although both movements occur at slow rate, the Court is satisfied that whether or not the gases produced by polymer decomposition are swept away as

⁹² Discovery of Dr. Michel Gauthier, May 28, 2009, at p 226-229 (Exhibit V-11, Tab 1, p 32-33).

proposed by Dr. Dahn, they are probably not moving from left to right against the inert gas flow.⁹³ That said, both experts agree, that in order for reduction to occur, it is important that the reductant (gases or carbon) is in close contact with the precursor materials. Dr. Dahn explained that considering the volume of gases produced during the heating of the polymer versus the size of the pellets they would not be in close contact with the precursors for more than about seven minutes. Dr. Bale's answer to this was general and rather vague. He never attempted to quantify how long there would be such a close contact. The Court does not accept the "sponge theory" put forth by Phostech's counsel during the cross-examination of Dr. Dahn anymore than this expert accepted it.

[176] As to point 6 referred to by Phostech's counsel, the Court notes that Dr. Dahn readily agreed that the variation in carbon weight alone is not determinative of anything given that carbon is produced by other components such as lithium carbonate. He did explain that he never considered this information alone. Rather it was a factor consistent with the information he derived from all the other tests.

[177] Before concluding, it is worth mentioning if only for their anecdotal value that Dr. Whittingham himself when reviewing example 5 in the '129 Patent believed that the posita⁹⁴ would conclude that the reduction was done through CTR, the carbon source being the polymer used in the experiment. A similar opinion appears to have been held by Dr. Zaghbi of the Institut de Recherche d'Hydro Québec (IREQ) who co-authored a paper, the abstract of which is filed as Exhibit V14, with Dr. Ravet and Dr. Gauthier. In this publication, the authors report on the results obtained on the new generation of LiFePO₄ from Phostech used in lithium ion batteries operating at 60°C. The

⁹³ Dr. Bale noted that the gas flow was sufficient to prevent water vapour from going to the right end of the tube and coming into contact with the final product (Exhibit P-7, p 5).

formation of the relatively pure LiFePO_4 is said to be “the net result of carbo-thermal effect, the carbon coating and also the careful selection of the Fe^{3+} precursor”. Obviously, this evidence was not given any weight as neither proponent testified as an expert in that respect and Drs. Ravet and Gauthier noted that they did not agree with this description.

[178] The Court concludes that Phostech’s P1 Process infringes claim 3 of the ‘115 Patent. As mentioned, the validity of this patent is no longer challenged, thus there is no need for the Court to determine whether the P1 Process infringes the second and third patent at issue. I will simply say that Dr. Dahn’s evidence in that respect was generally credible and in line with the construction adopted by the Court. The evidence in respect of the link required by claim 26 between the final product and the carbon was not very clear but if the coating is, as described by Dr. Gauthier, like nail polish it must be ultimately attached or closely associated with the LiFePO_4 .

3. Validity

[179] For the reasons explained in *Eli Lilly*, above, at paragraph 349 to 369, the merits of Phostech’s defence and counterclaim based on the invalidity of the Valence patents will be assessed on the basis that the Defendant must establish, on a balance of probabilities, any facts which by virtue of the *Patent Act*, or by any other laws, render invalid the ‘366 or ‘918 Patent, keeping in mind the applicable presumption as to their validity.

⁹⁴ This example was said to be the basis of Phostech’s P1 process.

[180] During oral arguments, Phostech dropped all of its attacks in respect of the ‘115 Patent and the major portion of its attacks⁹⁵ on the ‘366 Patent leaving only the following two issues:

- a. Insufficiency of the disclosure in respect of the expression “source of carbon”⁹⁶ and “linked by being nucleated or bound to carbon” used in claim 26 considering as mentioned earlier that this last expression is meant to include “coating” (dependent claim 31);
- b. Valence misappropriated the claims in the original ‘129 Application of Phostech and misrepresented to the Patent Office that three of its employees were the inventors of the invention described in those claims, the whole contrary to section 53(1) of the *Patent Act*.

[181] With respect to the ‘918 Patent, although Phostech maintains all the issues raised in its last Statement of Defence, for reasons explained below, the Court will only need to deal with anticipation.

a. The ‘366 Patent - Insufficiency

[182] Pursuant to subsection 27(3) of the *Patent Act*, the inventor must define the nature of the invention and describe how it is put into operation. To be sufficient a patent disclosure must provide

⁹⁵ These were all summarized in the claim charts filed as Judge’s Aids. Although Phostech’s counsel mentioned at the hearing that the ‘366 Patent was an improper divisional because the disclosure was insufficient to support it, there is nothing in the claims charts or in Phostech’s written submissions in that respect other than the general arguments based on ss. 27(3). There was also no argument raised in respect of double patenting between the ‘115 Patent and the ‘366 Patent, only in respect of the ‘366 Patent and the ‘918 Patent.

⁹⁶ In its written submissions (Plan de plaidoirie), Phostech does not deal with “source of carbon”, see paragraph 240 to 250. However, when Valence responded to the invalidity argument raised it noted that in respect of insufficiency both expressions were challenged without any objection from Phostech’s counsel. To ensure that nothing is left out, the Court will deal with both expressions. See also page 21-22 of the claim chart filed as Judge’s Aid No. 20.

enough information for a posita to use the invention as successfully as the patentee or in other words to put the invention into practice (*Consolboard Inc. v MacMillan Bloedel (Saskatchewan) Ltd.*, [1981] 1 SCR 504 at p. 525).

[183] The Federal Court of Appeal recently reviewed the principles applicable to insufficiency and section 27(3) in *Pfizer Canada Inc. v Canada (Minister of Health)*, 2008 FCA 108. Among other things, the Court noted that:

36 In *Hughes and Woodley on Patents*, 2nd ed., Volume 1, at 333, the authors describe the requirement that a disclosure be sufficient as follows:

Insufficiency is directed to whether the specification is sufficient to enable a person skilled in the art to understand how the subject matter of the patent is to be made [...] An allegation of insufficiency is a technical attack that should not operate to defeat a patent for a meritorious invention; such attack will succeed where a person skilled in the art could not put the invention into practice.

[Emphasis added]

37 Subsection 27(3) of the Act does not require that a patentee explain how well his invention works in comparison to other inventions. He is not required to describe in what respect his invention is new or useful, nor is he obliged to "extol the effect or advantage of his discovery, if he describes his invention so as to produce it": see *Consolboard, supra*, at 526.

...

56 The Applications Judge was wrong in interpreting the disclosure requirement of subsection 27(3) of the Act as requiring that a patentee back up his invention by data. By so doing, he confused the requirements that an invention be new, useful and non-obvious with the requirement under subsection 27(3) that the specification disclose the "use" to which the inventor conceived the invention could be put: see *Consolboard, supra*, at 527. Whether or not a patentee has obtained enough data to substantiate its invention

is, in my view, an irrelevant consideration with respect to the application of subsection 27(3). An analysis thereunder is concerned with the sufficiency of the disclosure, not the sufficiency of the data underlying the invention. Allowing Ranbaxy to attack the utility, novelty and/or obviousness of the 546 patent through the disclosure requirement unduly broadens the scope of an inventor's obligation under subsection 27(3) and disregards the purpose of this provision.

57 While it is true that subsection 27(3) requires that an inventor "correctly and fully describe" his invention, this provision is concerned with ensuring that the patentee provide the information needed by the person skilled in the art to use the invention as successfully as the patentee. The Supreme Court of Canada, in *Consolboard*, supra, at 526, cited with approval the following passage from *R. v. American Optical Company et al* (1950), 13 C.P.R. 87, 11 Fox Pat. C. 62 at p. 85:

... It is sufficient if the specification correctly and fully describes the invention and its operation or use as contemplated by the inventor, so that the public, meaning thereby persons skilled in the art, may be able, with only the specification, to use the invention as successfully as the inventor could himself.

[Emphasis added]

58 The requirement that the specification of a patent be truthful and not be misleading is not covered by subsection 27(3), but rather by subsection 53(1) of the Act, which reads as follows:

Void in certain cases, or valid only for parts

53. (1) A patent is void if any material allegation in the petition of the applicant in respect of the patent is untrue, or if the specification and drawings contain more or less than is necessary for obtaining the end for which they purport to be made, and the omission or addition is wilfully made for the purpose of misleading.

* * *

Nul en certains cas, ou valide en partie seulement

53. (1) Le brevet est nul si la pétition du demandeur, relative à ce brevet, contient quelque allégation

importante qui n'est pas conforme à la vérité, ou si le mémoire descriptif et les dessins contiennent plus ou moins qu'il n'est nécessaire pour démontrer ce qu'ils sont censés démontrer, et si l'omission ou l'addition est volontairement faite pour induire en erreur.

59 Only two questions are relevant for the purpose of subsection 27(3) of the Act. What is the invention? How does it work?: see *Consolboard, supra*, at 520. In the case of selection patents, answering the question "What is the invention?" involves disclosing the advantages conferred by the selection. If the patent specification (disclosure and claims) answers these questions, the inventor has held his part of the bargain. In the case at bar, the 546 patent answers each of these questions.

[184] It is important to mention that the comments of Justice Roger Hughes in *Ratiopharm Inc. v Pfizer Ltd.*, 2009 FC 711, in respect of subsection 27(3) (as well as those relating to ss. 53(1)) were described by the Federal Court of Appeal as simple “*obiter*”⁹⁷ (2010 FCA 204 at para 2).

[185] The only written evidence filed by Phostech that can have any relevance to this argument which was entitled “overbreath and insufficiency” in its written representations (page 82, section E), is found in Exhibit P-27, Tab F at page 164 where Dr. Whittingham essentially states that i) there is no support in the specification for any reductant other than carbon itself, ii) the term “source of carbon” is not itself used and iii) there is no example where a source of carbon other than carbon itself is used.

[186] These comments appear to be closely linked to Dr. Whittingham’s views about the meaning

⁹⁷ Phostech focused on this version to support its insufficiency argument particularly in respect of the misappropriation discussed later at paras 195 – 208 (see Plan de plaidoirie de Phostech at paras 217 – 227).

of the technical terms in claim 26. As discussed under construction above, all the other experts agreed that the posita would understand “source of carbon” to include the type of binders that carbonize at temperatures below that used for the reduction, as disclosed at page 13 of the specification.

[187] Apart from these bald statements, Dr. Whittingham did not explain exactly what information would be missing to enable a posita to use the invention described in claim 26. There is no evidence that the carbon produced by the carbonization of the binder would react any differently than the particles of carbon focused on by Dr. Whittingham. Except for a brief comment that will now be discussed, there is no evidence that a posita would need more information to be able to use the carbon in the residue to perform CTR. In this respect, Dr. Whittingham responded to a question from the Court that he would not know off-hand which polymers would totally evaporate as opposed to carbonize.⁹⁸ He admitted knowing that certain polymers like sugar would carbonize but said that he would need to do a test before using one which he did not readily know about. There is no evidence, however, that such a test is anything but a standard test (not involving an inventive step) that one would be expected to perform before using an unfamiliar reactant. Also, even if there were a few examples in the ‘366 Patent using a binder/polymer referred to at page 13, would a posita not be expected to have to do the exact same test, or at least look up in available literature, the particularities of a polymer not specifically used in the examples?

⁹⁸ Transcript of September 13, 2010 at p. 150 – 151.

[188] The Court notes that in the '129 Application on which Phostech relies heavily to support its argument of misappropriation, there are a few examples of polymers that decompose to produce a carbon residue, however at page 37, line 10-11 when discussing "cellulose acetate", the inventor simply referred to "the literature" (no citation) giving the carbonation yield for that polymer. The fact that no specific article is cited would indicate that this is literature that is commonly known or at least readily available to a posita.⁹⁹ This is perfectly in line with the evidence of Dr. Dahn who referred to a standard textbook dealing with the pyrolysis of polymers.

[189] With respect to the "linked by being nucleated or bound to carbon", it appears that the main issue raised by Dr. Whittingham in Exhibit P-27, Tab F, p. 163 to 164 (para. 8) is again one of construction. Would one understand that the nucleation or bond required the existence of an Li-C or a chemical bond with the lithium itself rather than with the whole compound such as LiFePO_4 ? For reasons already explained, the Court preferred the evidence of the other experts on this point, especially considering that in the end, Dr. Whittingham admitted that it would make little sense to construe the sentence as he initially did. His approach was simply too literal, it would not make any sense to a posita with a mind willing to understand.¹⁰⁰

[190] But interestingly in the referenced paragraph, Dr. Whittingham also refers to the "well known and common practice of adding carbon to the cathode material" to provide electronic conductivity to the cathode structure¹⁰¹ and expressly notes that "in such cases the carbon material is to be nucleated on the surface of the metal compound". Does this not indicate that once the claim is

⁹⁹ It is reasonable to infer that the posita would be the same for the '115, '366 and '918 Patents given the similarity of the subject matter.

¹⁰⁰ Phostech ultimately abandoned the argument on the "of the" (i.e. "the lithium of the metal compound).

¹⁰¹ See also para 74 and note 54, above.

properly construed, the posita would have no difficulty understanding the concept of nucleation between the metal compound as a whole and the carbon?¹⁰²

[191] In its written representations at paragraphs 244 to 250, Phostech put much emphasis on a passage of the testimony of Dr. Cairns (Transcript of September 15, 2010, page 78, line 15 to page 79). In fact, Dr. Cairns simply stated that in his view the nucleation referred to on page 8 of the disclosure is a hypothesis put forth by the inventors and nothing more. In effect, nowhere do the inventors attempt to substantiate that explanation. Dr. Cairns makes it clear (at page 84) however that the fact that he does not personally agree with this hypothesis did not prevent him from understanding claim 26.

[192] None of this constitutes evidence that the posita could not use the method described in claim 26 because there is insufficient technical details to support what the inventor describes as a hypothesis. This is especially so in a context where the inventor qualifies this hypothesis in claim 26 by using the words “linked by” and “or bound”. Moreover, there is no evidence that one must do anything other than what is clearly described in the disclosure to obtain the compound claimed as being linked by nucleation or bound to the residual carbon. From all the evidence presented, it appears to be the simple result of the heating of carbon intimately mixed with the precursor materials at the temperature referred to in the disclosure.

[193] It is not challenged that the excess carbon in the final product using the method described in the ‘366 Patent would increase the conductivity of the final product. This is the only advantage

¹⁰² See also the simple reference to nucleation in the ‘129 Application, p 11, line 28 which also appears not to require any further explanation.

promised in the '366 Patent in respect of such excess carbon. It is not challenged that using the method described would necessarily result in an intimate attachment or association between the final compound and the carbon, which is what the posita would understand claim 26 to mean.

[194] The Court is not satisfied that Phostech has met its burden of establishing that this patent should be voided on this basis of insufficiency.

b. The '366 Patent – Misappropriation and ss. 53(1)

[195] Section 53(1) of the *Patent Act* reads:

53. (1) A patent is void if any material allegation in the petition of the applicant in respect of the patent is untrue, or if the specification and drawings contain more or less than is necessary for obtaining the end for which they purport to be made, and the omission or addition is wilfully made for the purpose of misleading.

53. (1) Le brevet est nul si la pétition du demandeur, relative à ce brevet, contient quelque allégation importante qui n'est pas conforme à la vérité, ou si le mémoire descriptif et les dessins contiennent plus ou moins qu'il n'est nécessaire pour démontrer ce qu'ils sont censés démontrer, et si l'omission ou l'addition est volontairement faite pour induire en erreur.

[196] It is now well established that to meet the requirement of this section, Phostech has to establish that a “material misrepresentation” was made and that it was made “willfully ... for the purpose of misleading”. As mentioned by Justice Hughes in *Eli Lilly Canada Inc. v Apotex Inc.* 2008 FC 142 at paras 62-63, aff'd 2009 FCA 97, an allegation pursuant to s. 53 “implicates the notion of fraud”.

[197] Phostech relies heavily on the comments of Justice Hughes in *Ratiopharm*, above, to say that the Court must infer from the inappropriate use of substantial portions of the claims of the '129 application in the particular context it was made that Valence intentionally misled the Patent Office as to who were the real inventors of the invention claimed in the '366 Patent.¹⁰³

[198] Here is it important to mention that when Justice Hughes' main finding that the patent at issue in *Ratiopharm*, above, was void on the basis of obviousness was confirmed by the Federal Court of Appeal (2010 FCA 204), the said Court said at paragraph 34:

Pfizer expressed concern that the trial judge's determination pursuant to subsection 53(1) of the Act was based on an overly broad interpretation of that subsection. I am of the view that the determination is confined to the unique and particular circumstances of this matter. It has limited, if any, value as a precedent.

[199] In *Ratiopharm*, above, Justice Hughes made it very clear that the situation before him was quite exceptional. In the context of a lengthy trial, he heard evidence from the two inventors of the patent at issue who explained exactly their respective involvements, what test they had carried, what had not been done, what real advantage they found in testing the claimed compound versus other compounds of the same class. The learned judge was able to conclude that there were several material misrepresentations in the patent before him. It is also evident that he was intimately convinced that these had been done intentionally by the patentee in order to ensure that it would get a patent.

[200] Here, regardless of the intrinsic value of the comments made by Justice Hughes on the law, I am satisfied that the case before me is substantially different not only because of the context but also

¹⁰³ Also meant to apply to the '918 Patent.

because of the nature and extent of the evidence he had available (particularly from all the inventors) compared to what was available to this Court. For reasons that will be explained shortly, the Court is not willing to infer an intention to mislead in this matter.

[201] First before going any further, it is important to put Phostech's arguments in their proper context. At page 24, line 25 of the '129 Application (Exhibit P-18)¹⁰⁴ one finds the following statement:

We are reporting here, for the first time, the synthesis of a Li_xMXO_4 compound of olivine type, in this case LiFePO_4 produced by reduction of an iron (III) salt. Since the initial salts are no longer sensitive to oxidation, the synthesis process is greatly simplified. In addition, the possible use of Fe_2O_3 as a source of iron considerably reduces the cost of synthesizing LiFePO_4 . This material would thus be preferable to other cathode materials for lithium batteries, such as cobalt or nickel oxides in the case of lithium-ion batteries or vanadium oxides V_2O_5 or analogs that are less inoffensive to the environment.

[My emphasis.]

[202] We know that this was not the first report of the synthesis of LiFePO_4 produced by reduction of an iron (III) precursor material given that the application for the '115 Patent had been published on July 26, 2001, that is several months before the publication of the '129 Application.

[203] It is also an established fact that Dr. Ravet and her team had in their hands the '115 Patent application before the '129 was published. Apparently, this paragraph was kept while new examples were added together with language that would enable the inventors to distance themselves from

¹⁰⁴ English translation of the '129 Application from US Patent Application 2004/0086445 (Exhibit P-27, p 206-233) at para 0119.

CTR and the use of carbon as a reductant¹⁰⁵ while it played a role in the conductivity of the final product.

[204] It is also important to note that the '129 Application does not claim the carbon coating of the final product. This invention was already covered by the '119 Patent.¹⁰⁶ Thus the similarities between the '115 and the '366 Patents and the '129 Application are evident as the respectively named inventors meant to patent a method for the synthesis of a lithiated metal compound starting from a precursor that has a higher oxidation state and which includes the incorporation of carbon prior to the synthesis of the active cathode material to improve its conductivity.

[205] We will never know for sure who actually first got the "idea"¹⁰⁷ of using Fe^{3+} or even of adding carbon before the synthesis of the active product as opposed to afterwards, as was customarily done at the time.

[206] For patents filed before October 1, 1989 (old Act), such determination used to be done through the conflict process provided for at section 43. However, for patents filed after 1989, this should no longer be important given that the legislator decided to change the rule from "the first to invent" to the more widely used rule that "the first to file" is the one entitled to the patent. Needless to say, conflicts were not unusual for it often happened that different research teams would come to an invention at about the same time. The new rule avoided this difficult process that often lasted years.

¹⁰⁵ The Court did not have the benefit of reviewing the file wrapper for the '129 Application.

¹⁰⁶ Which was before the Patent Examiner.

¹⁰⁷ See the description of how Dr. Ravet came up with the invention described in the '119 Patent (Transcript of September 9, 2010 at p. 54-63).

[207] Phostech went to great length to establish something that was not really contested by Valence, that is, that its patent agent had recommended that Valence adopt in its divisional,¹⁰⁸ which had already been filed, wording which followed very closely that used in the claims of the '129 Application (or the related '446 Application) wherever there was sufficient material in the Valence disclosure to support such changes.

[208] This is not a novel strategy for it is exactly what one would have had to do under section 43(2) before a conflict was declared. William Hayhurst's chapter entitled "The Art of Claiming and Reading a Claim"¹⁰⁹ explains how it is the role of the patent agent to ensure, once he understands the invention as explained by the inventor(s) including his or her preferred embodiments (often their product or processes), that the claims cover not only what the inventor(s) already contemplated, but also variances one could reasonably foresee in the future that could make use of the contribution of the inventor(s) to the art. This means that the patent agent will not only review the prior art, but will keep current of new publications and developments in the field throughout the patent's prosecution. This also explains why one finds such a range of claims going from the widest claims that the agent can conceive of and that the Patent Office will allow, to the narrower claims that will cover, at the very least, the most likely competitive product or process.¹¹⁰

¹⁰⁸ The Court does not have a copy of all the file wrappers for the '115 and '366 Patents, but it is clear that by May 28, 2004, a divisional was filed with a different set of claims (Exhibit V-23a). By that time, the new pages 20a through 20r had already been filed.

¹⁰⁹ William L. Hayhurst, Q.C., "The Art of Claiming and Reading a Claim" in Gordon F. Henderson, ed., *Patent Law of Canada* (Toronto: Thomson, 1994) 177.

¹¹⁰ *Ibid* at p. 213.

[209] As mentioned by the distinguished authors, “[h]ence the old saw that ‘the inventor invents the product and the patent agent invents the invention’”.¹¹¹ This reflects the fact that, as mentioned by Mr. Hayhurst:

All too often the inventor does not understand the importance of claims or the niceties of claim drafting. All too often the inventor is content to ensure that the descriptive portion of the specification and any accompanying drawings are accurate, and that any prior art that may come to light can be distinguished, leaving the mysteries of claim drafting entirely to the agent. (p. 204)

[210] Because patent agents are also required to be familiar with patent law and the requirements of the *Patent Act*, it is evident that they will prefer to draft claims at the same time as the disclosure to avoid ambiguity and to ensure that the terms used in the claims are consistent with those used in the disclosure. That said, however, claims are subject to negotiation with the Patent Examiner during prosecution for various reasons, substantive amendments are made such as those required in ss. 43(2) of the old Act. This often later created difficulties that Court’s will have to grapple with when construing the claims. It will also raise the risk that the disclosure may be found inadequate (s. 27(3) / old s. 34). But this is what the patent agent must assess when claims from other applications or patents are included in one’s own application.

[211] The Court agrees with Valence that there is no copyright on claim language.

[212] What an inventor risks in borrowing language from others is to have his claims rejected by the Patent Office on the basis of 27(3) or because they become ambiguous or later voided by the Court on these bases. In this case, the Patent Examiner was satisfied that there was enough information to support these claims.

¹¹¹ *Ibid* at p. 204.

[213] No precedent has been cited to support the position put forth by Phostech that such behaviour would constitute a misappropriation of another's invention. I doubt very much that such situations were intended to be covered by ss. 53(1).

[214] All these comments which may appear somewhat superfluous are made to address the frustration and almost outrage expressed by Dr. Gauthier when he saw that so many expressions used in his patent application had been included in the '366 Application, including the famous "C-LiFePO₄".

[215] That said, to use the words of Justice Walsh in *Beloit Canada Ltd. v Valmet Oy* (1984), 78 CPR (2d) 1 (TD) at p. 30,¹¹² it "take[s] very strong evidence indeed and not merely deduction from the documentary evidence and suggestions of motives" to establish that the named inventor is not the inventor of the invention described in the said patent.

[216] This is especially so when it is not disputed that the inventors named in the '366 Patent were the authors of the disclosure of the '115 Patent Application filed before the '129 Application. It is on the basis of wording included in the said original disclosure that the Court was able to construe claim 26 of the '366 Patent. Moreover, it is on the basis of this disclosure that experts testified that the posita would be able to practice the invention described in claim 26.

¹¹² Reversed on another ground (1986), 8 CPR (3d) 289 (FCA).

[217] As mentioned earlier, there is little evidence from the inventors before the Court. Phostech filed by consent some extracts from the discovery of Dr. Barker, one of the three inventors named in the '366 Patent. There is little evidence as to the exact role played by Dr. Barker compared to that of the other two inventors in the development of the invention. Certainly, it appears from the correspondence before the Court that Dr. Barker felt that Yazid Saidi, one of the other inventors, could be of help in respect of some of the matters raised. Although no correspondence from Mr. Saidi was found, there is no evidence that he did not speak with the patent agent. Dr. Barker also directed some inquiries in relation to the making of the Valence product to Valence's quality control department. It is evident from the few extracts produced that Dr. Barker does not have a good memory of details. It is most likely that he was indeed personally involved in drafting the disclosure of the '115 Patent. He also probably chose the experiments reported therein. It is unlikely that he was involved at all in the drafting of the claims *per se*.

[218] Phostech's counsel focused on an answer to one of the questions put to him by the patent agent as to whether a particular wording used in the '129 Application (or the '466 equivalent) applied to the Valence product – did the Valence product have a core? His answer was “very difficult to tell”. Dr. Barker was never asked what he understood this question to mean exactly or whether he had with him a copy of the Armand application and, in any event, the reference to “core” was never used in the '366.

[219] None of this evidence establishes to my satisfaction that the named inventors did not invent what is claimed in the '366 Patent. No misrepresentation has been established in that respect.

[220] I should also say that Phostech has not satisfied me either that I should infer an intention to mislead. The Court does not accept the leap proposed by Phostech's counsel that Valence must have filed for a divisional to avoid having to deal with the patent examiner working on the '115 Application to by-pass some of the objections he had raised. There are many other explanations for requesting a divisional, especially when one knows that a competitor is or will soon be on the market with a product that may infringe. One could want to get a first patent issued quickly with claims language that one knows is acceptable to the examiner.

[221] Phostech's attack on the basis of ss.53(1) fails.

c. The '918 Patent - Anticipation

[222] The meaning of subsection 28.2 of the *Patent Act* and the principles applicable to determine if a claim is anticipated are well established, especially since the Supreme Court of Canada recently reviewed them in *Apotex Inc. v Sanofi-Synthelabo Canada Inc.*, 2008 SCC 61 at paras 24 – 29.

[223] Justice Marshall Rothstein on behalf of the Court made it clear that, as explained by Lord Hoffman in *Synthon B.V. v SmithKline Beecham plc*, [2006] 1 All ER 685, [2005] UKHL 59 at para. 22, to anticipate a prior disclosure must disclose subject matter which, if performed, would necessarily constitute infringement of the claim being challenged. In determining whether a publication contains sufficient disclosure, the document is to be read with a mind willing to understand and no experimentation is permitted.

[224] Because the disclosure must also be an **enabling** disclosure, like the patent at issue (ss. 27(3)) it must contain enough information that a posita would be able to use or practice the invention. There is a degree of trial and error experimentation permitted as long as said experimentation does not include an inventive step.

[225] The relevant claim date for claim 1 is May 17, 2002. It is not disputed that at that time the '129 Application had been published¹¹³ and was available to the public. In example 5,¹¹⁴ the following method is disclosed and practiced (my summary):

FePO₄ · 2H₂O (186.85g), Li₂CO₃ (36.94g) and cellulose acetate (11.19g) are ground up and mixed together. Among other things, this mixture is heated under a neutral atmosphere of argon gas at 400°C to enable the decomposition of the cellulose acetate and then to 700°C for a time sufficient to ensure a good crystallinity of the LiFePO₄ produced. The reported analysis confirmed that residual carbon is left in the pure LiFePO₄ compound produced by this method.

At page 37, lines 23 to 25 of the '129 Application, it is disclosed that the carbon from the cellulose acetate has the reducing power to act on the transition metal to reduce the Fe³⁺ to Fe²⁺. However, the inventors¹¹⁵ note that the amount of carbon actually consumed in the experiment was not sufficient to explain all of the reduction (lines 13 to

¹¹³ April 4th, 2002; see Chronology attached as Annex B.

¹¹⁴ The only one carried out without a reducing atmosphere of hydrogen.

¹¹⁵ Includes Drs. Gauthier and Ravet.

15). Thus, it was concluded that the gaseous atmosphere produced when the acetate decomposes must have intervened in the reduction process (lines 16 to 18).

[226] It is not disputed that the starting materials in Example 5 are precursor materials included in claim 1 of the '918 Patent. The source of carbon – the cellulose acetate is an organic material which upon heating forms a residue containing carbon in a form capable of acting as a reductant. Dr. Whittingham testified that it would be understood by a posita, reviewing this example or performing it, that CTR is involved and that carbon is a reductant.

[227] Valence challenged Phostech's allegation of anticipation on the basis that the '129 Application by saying that it teaches away from the use of CTR as an industrial process (Example 5); this is contrary to the teaching of the '918 Patent.¹¹⁶

[228] There is no doubt in my mind that example 5 in the '129 Application constitutes an enabling disclosure within the meaning of *Sanofi-Synthelabo Canada*, above, and that the method used following the instructions in this example would infringe claim 1 of the '918 Patent. Thus it anticipates the patent.

[229] The fact that the inventor in the '129 Application states that carbon would not be the sole reductant does not preclude this disclosure from being an enabling disclosure given that as

¹¹⁶ Exhibit V-20 at paras 174, 175 and 177.

construed by Valence's own experts, there is no requirement in claim 1 of the '918 Patent that carbon (or CTR) be the sole reductant.¹¹⁷

[230] Dr. Cairns was clear that although the new subject matter in the '918 Patent was the extension of the invention claimed in the '115 and '366 Patents to a wider set of inorganic compounds, claim 1 as drafted did overlap and include all the compounds described in the '115 and '366 Patent and more particularly LiFePO_4 described in example 5 of the '129 Application. Had the inventors put the fences around their monopoly more precisely, the '129 Application would not have anticipated it. They chose not to do so and as Justice Binnie said in *Whirlpool* they ran the risk of losing everything.

[231] The Plaintiff agreed that if claim 1 was found invalid the remaining 11 claims would also be invalid. The Court finds that the '918 Patent is void.

4. Remedies and Cost

[232] Phostech has produced LiFePO_4 since June 2002. Pursuant to subsection 55(2) of the *Patent Act*, a patentee is entitled to reasonable compensation for the time period between when the application became open to the public (July 26, 2001) and the patent issued (July 20, 2004).

[233] Reasonable compensation is not identical to damages; rather it is in the nature of reasonable royalty. The amount of such royalty will be determined in accordance with the order bifurcating the quantification of the damages or profit at a later stage.

¹¹⁷ See page 4 of the Claim Chart filed as Judge's Aid No. 21.

[234] For the period after the issuance of the '115 Patent, Valence seeks the right to elect between its damages and an accounting of profits. The principles applicable in that respect are well established (see *Eli Lilly*, paragraph 647-648) where I summarized them as follows:

With regard to the remedy of an accounting of profits, the Federal Court of Appeal has recently reiterated the well established principle that "a trial judge has complete discretion in deciding whether or not to grant this equitable remedy" (*Merck & Co. (FCA)*). It is equally well established that a successful plaintiff in a patent case does not automatically benefit from this remedy. In *AlliedSignal Inc. v. Du Pont Canada Inc.* (1995), 95 F.T.R. 320 n, 184 N.R. 113 (F.C.A.), Justice Alice Desjardins held that "the choice between the two remedies [damages or accounting of profits] cannot be left entirely to the successful plaintiff." (para. 77)

In past cases, the right to elect has been denied for a variety of reasons; delay in bringing forward the action for infringement (*Consolboard (1978)*); "misconduct on the part of the patentee" and "the good faith of an infringer" (*Beloit Canada Ltd. v. Valmet-Dominion Inc.*, [1997] 3 F.C. 497, 214 N.R. 85 (F.C.A.), paras. 111 and 119); and, where "the Plaintiffs essentially threw in the towel and left this action to proceed in a leisurely fashion" (*Merck & Co. v. Apotex Inc.*, 2006 FC 524, 282 F.T.R. 161, (*Merck & Co. (FC)*) para. 229). Obviously, all of these cases are very fact specific and quite distinguishable from the present situation. Still, they are useful with respect to factors to be considered in the course of the exercise of this Court's discretion.¹¹⁸

[235] In this case, Phostech argued that Valence did not come to Court with clean hands because of the facts referred to above in respect of section 53(1). Moreover, it says it was acting in good faith and that Valence unnecessarily prolonged the proceeding by relying on 107 claims of its patents until April 2010.

¹¹⁸ Recently, Justice Judith Snider used her discretion to preclude such election in *Merck & Co. v Apotex*, 2010 FC 1265 at para. 624.

[236] The Court does not find that there were undue delays in the prosecution of this matter. As explained at the first trial management conference, the Court thought that it was excessive to rely on 107 claims at that stage of the proceeding given that a judgment in respect of one claim will suffice. Also, until the beginning of the trial, Phostech itself was insisting that the Court review the validity of each and every one of the claims of the three patents (over 230 claims). It was only the Court's repeated requests that prompted the parties to re-examine their mutual position. Obviously, the Court is thankful for this and neither party should be punished for adopting such a reasonable attitude.

[237] As mentioned earlier, the Court is satisfied that neither party acted in bad faith. Also, as acknowledged by Dr. Ravet in 2006, Phostech did represent to the world that it used CTR. Valence was certainly entitled to assert its rights under its Patents. There is no question of abuse here.

[238] All this to say that the Court is not satisfied that it is not appropriate to exercise its discretion in favour of the election. Valence shall be entitled to make such an election.

[239] Phostech argues that the Court should exercise its discretion not to grant an injunction until it is in a position to use its P2 process at the new factory being built in Quebec. It says that the Court should give it a two year grace period because the said installation will not be ready before at least 2012. In that respect, it relies on *Unilever PLC v Procter & Gamble Inc.* (1993), 47 CPR (3d) 479 at p. 572 and *Merck & Co. v. Apotex Inc.*, 2006 FC 524 at para. 230.

[240] This caselaw is clearly distinguishable on its facts. The Court should refuse to grant a permanent injunction where there is a finding of infringement, only in very rare circumstances. I am not satisfied that those raised in this case warrant such an exception.

[241] The parties made no particular submissions in respect of the interest sought by Valence (draft order submitted). Valence's request certainly reflects the views I expressed in *Eli Lilly*, above, at paras 665 to 675. I have no reason to reach a different conclusion here.

[242] The parties did not make any submissions in respect of the order sought that the infringing products be delivered up to Valence. The Court is not sure why in the particular context (nature of the products of the parties, confidentiality issues, etc.) it would not be more appropriate to ensure that the material is destroyed. If the parties cannot come to an agreement in this respect, they shall file written submissions (maximum 5 pages). The Court will retain its jurisdiction until then and a revised judgment or distinct order will be issued.

[243] With respect to costs, the parties are agreed that because of the possibility that rule 420 may apply, the Court should deal with costs in a distinct order after giving them a further opportunity to make representations in this respect. Each party shall be entitled to file written submissions (5 pages maximum) on or before February 25th, 2011.

JUDGMENT

THIS COURT ORDERS AND ADJUDGES that:

1. The Defendant, Phostech Lithium Inc., has infringed at least claim 3 of Canadian Patent No. 2,395,115, by manufacturing, distributing, offering for sale, selling, licensing or otherwise making available in Canada lithium iron phosphate (LiFePO₄) cathode materials made using the Defendant's P1 Process;
2. The Plaintiff shall be entitled to reasonable compensation for the acts of Defendant under section 55(2) of the *Patent Act*, RSC 1985, c P-4 from the time that the application for the Canadian Patent No. 2,395,115 became open to public inspection until its date of issue. Such damages will be assessed by reference preceded by discovery if requested;
3. The Plaintiff is entitled to elect either an accounting of profits of the Defendant or all damages sustained by reason of sales directly lost as a result of the infringement by the Defendant of the above-mentioned patent. Such damages will be assessed by reference preceded by discovery if requested;
4. The Plaintiff shall be entitled to pre-judgment interest on the award of damages (if elected), not compounded, at a rate to be calculated separately for each year since the infringing activity began at the average annual bank rate established by the Bank of Canada as the minimum rate at which it makes short-term advances to the banks listed in Schedule 1 of the

Bank Act, RSC 1985, c B-1. However, such award is conditional upon the reference judge not awarding interest under paragraph 36(4)(f) of the *Federal Courts Act*, RSC 1985, c F-7;

5. In the event that the Plaintiff elects an accounting of profits, interest shall be determined by the reference judge;
6. The Plaintiff shall be entitled to post-judgment interest not compounded, at a rate of 5% per annum, as established by s. 4 of the *Interest Act*, RSC 1985, c I-15. This interest shall commence upon the final assessment of the monetary damage amount or profits amount, until then pre-judgment interest shall prevail;
7. The Plaintiff is granted an injunction to restrain the Defendant by itself or by its shareholders, directors, officers, agents, servants, employees, affiliates, parent company, subsidiaries, or any other entity under its authority or control and each of them from:
 - a. Manufacturing, using or selling to others, or inducing and procuring others to manufacture, lithium iron phosphate (LiFePO_4) cathode materials made using the Defendant's P1 Process or any similar process that infringes upon Canadian Patent No. 2,395,115;
 - b. Directly or indirectly infringing any claims of Canadian Patent No. 2,395,115;

8. The parties shall have until February 25, 2011 to advise the Court if an order with respect to the delivery up or the destruction of the infringing products will be required. If so, they shall all by the same date file their submissions in that respect.
9. The Plaintiff's costs in this action to be dealt with in a distinct order.
10. The Defendant's counterclaim is granted in respect of the 2,483,918 (the '918 Patent) only. Said patent is declared null and void, costs to be dealt with in a distinct order as per the above.
11. The parties shall file new written submissions as to the amount of said costs in the manner set out in my reasons on or before February 25, 2011.

“Johanne Gauthier”

Judge

ANNEX B

The parties submitted the following Agreed Chronology of Events on September 20, 2010:

<u>Year</u>	<u>Date</u>	<u>Description</u>	<u>Exhibit</u>
1956			
	February 28	US Patent No. 2,736,708 (issued)	Trial P-32 JBD-11 (P-8)
1995			
	November 7	Japanese Patent Application No. JP H9-134725 (filing date)	Trial P-31 JBD-10 (P-7)
1996			
	April 23	Canadian Patent No. 2,251,709 (filing date) (Goodenough)	Trial P-19 JBD-38 (P-35)
	September 23	US Patent No. 5,871,866 (filing date)	Trial P-40 JBD-27 (P-21) <i>* filed by agreement</i>
1997			
	May 20	Japanese Patent Application No. JP H9-134725 (Publication date)	Trial P-31 JBD-10 (P-7)
	Oct. 30	Canadian Patent No. 2,251,709 (Publication date)	Trial P-19 JBD-38 (P-35)
	November 4	US Patent No. 5,683,835 (issued)	Trial P-33 JBD-12 (P-10)
1999			
	Feb. 16	US Patent No. 5,871,866 (Publication date)	Trial P-40 JBD-27 (P-21)

	April 6	English translation of Japanese Patent Application 11-099407 (filing date)	Trial P-29 JBD-8
	April 6	Priority date of Canadian Patent Application No. 2,334,386	Trial P-30 JBD-9
	April 30	Canadian Patent Application No. 2,270,771 (filing date)	Trial P-10 JBD-40 (P-37)
	April 30	Priority date for Canadian application No 2,307,119	Trial P-14 JBD-14 (P-11)
	October 17-22	Improved Iron Based Cathode Material, Ravet (Presentation Honolulu 1999)	Trial P-11 (JBD-28) P-23
	October 17-22	LiFePO ₄ as Cathode Material for Rechargeable Lithium Battery, Besner (Presentation Honolulu 1999)	Trial P-12 JBD-29 (P-24)
	October 17-22	New Lithium Ion Polymer Technology at Hydro-Quebec, Vallée (Presentation Honolulu 1999)	Trial P-13 JBD-30
2000			
	January 18	Priority date for 115 Patent and 366 Patent	Trial V-1 JBD-1 (‘115) Trial V-2 JBD-3 (‘366)
	May	<i>Abstract</i> <i>Electro-activity of Natural and Synthetic Triphylite</i> , Ravet, Chouinard, Magnan, Besner, Gautheir, Armand, Journal of Power Sources, 97-98 (2001), 503-507	Trial P-15 JBD-31 (last page)
	September 26	Canadian Patent Application No. 2,423,129 (priority date)	Trial P-18 JBD-16 (P-12)
	September 26	Canadian Patent Application No. 2,422,446 (priority date)	Trial P-20 JBD-25 (P-20)

	October 12	English translation of Japanese Patent Application 11-099407 (Publication date)	Trial P-29 JBD-8
	October 12	Canadian Patent Application No. 2,334,386 (Publication date)	Trial P-30 JBD-9
	October 30	Certified copy of Canadian Patent Application No. 2,270,771 (Publication date)	Trial P-10 JBD-40 (P-37)
	October 30	Publication date for application for 119 Patent	Trial P-14 JBD-14 (P-11)
	December 22	Filing date for '115 patent	Trial V-1 JBD-1
2001			
	July	<i>Electro-activity of Natural and Synthetic Triphylite</i> , Ravet, Chouinard, Magnan, Besner, Gauthier, Armand, Journal of Power Sources, 97-98 (2001), 503-507	Trial P-15 JBD-31 P-26 (paper)
	July 1-6	<i>Lithium Iron Phosphate: Towards a Universal Electrode Material</i> , Ravet, Magnan, Gauthier, Armand, Presentation at ICMAT 2001, Singapore, July 1-6, 2001	Trial P-17 JBD-18 (P-13)
	July 26	Publication date for application for '115 patent and 366 patent	Trial V-1 JBD-1 ('115) Trial V-2 JBD-3 ('366)
	August 17	Hydrothermal synthesis of lithium iron phosphate cathodes, Yang, Whittingham & al.	Trial P-27 (Exhibit J, page 190) JBD-61 (P-53)
	August 20	Approaching Theoretical Capacity of LiFePO ₄ at Room Temperature at High Rates, H. Huang, S.-C. Yin and L.F. Nazar ECS, 4(10 A-170 – A-172)	Trial P-27 (Exhibit J, page 187) JBD-20 (P-54)
	September 21	Filing date for '129 application	JBD-16
	November 13	Multipart Invention Disclosure Form ID No. 2440	Trial P-35 JBD-186

2002			
	April 4	Publication date for 129 application	Trial P-18 JBD-16 (P-12)
	April 4	Publication date for 446 application	Trial P-20 JBD-25 (P-20)
Only priority	May 17	Priority date and filing date for 918 Patent	Trial V-3 JBD-5
	July	First commercial sale Phostech	
2003			
	March 17-20	Carbon-coated Lithium Iron Phosphate. Road to Commercialization, Presentation by Phostech at the Florida Educational Seminars, 20 th International Seminar and Exhibit on Primary and Secondary Batteries	Trial P-24 JBD-23
	May 6	Filing date for 918 Patent	Trial V-3 JBD-5
	June 1	Phostech Patent Licence Agreement with Hydro-Quebec and University of Texas (Goodenough)	Trial P-21 JBD-39
	July 2	Purchase Order by Valence to Phostech	Trial P-25 JBD-35
	September 16	“Long-term Cyclability of Nanostructured LiFePO ₄ ”, Prosini et al., <i>Electrochimica Acta</i> 48 (2003) 4205-4211	Trial P-34 JBD-32
	December 4	Publication date for application for 918 Patent	Trial V-3 JBD-5
	December 9	Office action ‘115, page 7 requires starting materials to be in particulate form	Trial P-39A (page Val-039 – B-231) JBD-2 (V-39B-231)
2004			
	February 4	Voluntary amendment ‘115	Trial P-39A (page Val-039 – B-191)

			JBD-2 (V-39B-191)
	May 21	Licence Agreement (Patent Application '129 & '446)	Trial P-22 JBD-66
	May 21	Licence Agreement (Patent Application '119)	Trial P-23 JBD-67
	May 28	Petition for '366 patent	Trial V-23A (page Val-041 – B-295) JBD-4 (V-41B-295)
	July 20	Issue date 115 Patent	Trial V-1 JBD-1 ('115)
	October 8	Supply Agreement between Phostech and Valence	Trial P-26 JBD-34
2005			
	June 30 8:36:26 a.m.	E-mail from Cindy Kovacevic to Sharon Lango Re. US2004/0086445 and US 2004/0033360 UT-22 – November 2 answers to questions ordered	Trial P-36F, tab F JBD-175 V-110
	June 30 8:41:37 a.m.	E-mail from Cindy Kovacevic to Sharon Lango Re. US2004/0086445 and US 2004/0033360 UT-22 – November 2 answers to questions ordered	Trial P-36F, tab F JBD-176 V-111
	July 5	Exchange of e-mails between Jerry Barker and Cindy Kovacevic & Yazid Saidi Re. VT-2005 Canada UT-101 & UT-102	Trial P-36F, tab K JBD-214 V-149
	July 13	E-mail from Cindy Kovacevic to Sharon Lango Re. Canadian Patent Application SN 2,466,366 UT-22 – November 2 answers to questions ordered	Trial P-36F, tab F JBD-178 V-113
	August 15	E-mail from Cindy Kovacevic to Sharon Lango Re. Proposed Claims for Voluntary Amendment UT-22 – November 2 answers to questions	Trial P-36F, tab F JBD-179 V-114

		ordered	
	August 17	E-mail from Cindy Kovacevic to T. Williams Re. Proposed Claims for Voluntary Amendment UT-22 – November 2 answers to questions ordered	Trial P-36F, tab F JBD-180 V-115
	August 23	Amendment to claims of application for 366 Patent	Trial V-23C (page VAL-041 – B-229) JBD-4 (V-41B-229)
2007			
	January 9	Issue date 918 Patent	Trial V-3 JBD-5
	January 31	Commencement of lawsuit T-219-07	
	March 27	Issue date 366 Patent	Trial V-2 JBD-3

FEDERAL COURT

SOLICITORS OF RECORD

DOCKET: T-219-07

STYLE OF CAUSE: VALENCE TECHNOLOGY, INC. v. PHOSTECH LITHIUM INC.

PLACE OF HEARING: Montreal, Quebec and Toronto, Ontario

DATE OF HEARING: September 1, 2, 3, 7, 8, 9, 10, 13, 14, 15 and 16, 2010
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REASONS FOR JUDGMENT: GAUTHIER J.

DATED: February 17, 2011

APPEARANCES:

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