IN THE HIGH COURT OF NEW ZEALAND
AUCKLAND REGISTRY

CIV-2009-404-002171

	BETWEEN	BALLANCE AGRI-NUTRIENTS LIMITED Appellant
	AND	RAVENSDOWN FERTILISER CO-OPERATIVE LIMITED & LINCOLN UNIVERSITY Respondent

Hearing: 23-25 August 2010

Appearances: B W F Brown QC, K W McLeod and A M Baker for Appellant
J G Miles QC and R Wallis for Respondent

Judgment: 4 March 2011

JUDGMENT OF COURTNEY J

This judgment was delivered by Justice Courtney
on 4 March 2011 at 3:30 pm
pursuant to R 11.5 of the High Court Rules.

Registrar / Deputy Registrar
Date…….

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Introduction

[1] Ravensdown Fertiliser Co-operative Limited and Lincoln University[1] have obtained a grant of patent relating to a soil treatment method.[2] Ballance Agri-Nutrients Limited appeals the decision granting the patent.

[2] The claimed invention relates to a method of applying the nitrification inhibitor dicyandiamide (DCD) to grazed pasture soil so as to reduce nitrate and cation leaching, reduce nitrous oxide emissions and increase pasture production.[3] The main sources of nitrogen in New Zealand are fertilisers and urine from grazing animals. Nitrogen from these sources reaches the soil in the form of ammonium nitrogen. However, nitrosomas bacteria in the soil convert ammonium nitrogen to the nitrate form in a process called nitrification. The consequences of nitrification are the leaching of nitrate from the soil and emission of the greenhouse gas nitrous oxide into the atmosphere. The result is less plant growth and pollution of air and groundwater. Nitrification inhibitors such as DCD act on the nitrosomas bacteria in the soil to prevent or slow down the nitrification process.

[3] Ravensdown claims that the conventional use of DCD has been limited to application in conjunction with the nitrogen source. It says that its method of general application of DCD to grazed pasture is new because it targets the soil and thereby responds to all sources of nitrogen, especially the random deposits from animal urine. It says, further, that DCD has not previously been used in this way to reduce nitrate/cation leaching and nitrous oxide emissions or to increase pasture growth.

[4] Ballance, however, asserts that there is nothing new or inventive in either Ravensdown's method or claimed purposes. It asserts that the Ravensdown method was anticipated by prior publications and use, that it is obvious, and that it is not a proper subject matter for an invention in terms of the Patents Act 1953.

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[1] Referred to collectively as Ravensdown.
[2] Assistant Commissioner Popplewell P/2009, 23 March 2009.
[3] The claim is annexed to this judgment.

Issues arising on appeal

[5] Ballance asserted that Assistant Commissioner Popplewell erred in:

a) Allowing amendments to three of the claims under s 40(1) Patents Act 1953;

b) Identifying particular witnesses as equating to the "skilled addressee". This issue is relevant to both novelty and obviousness;

c) Finding that the claimed invention had not been anticipated through publication in the NZ Agrichemical Manual before the priority date. Subsequent to the hearing Ballance obtained leave to argue prior publication in the form of the abstract of a paper published by W R Cookson and Professor Cornforth in June 2002 and an advertisement published in July 2002 for a product called SupaCrop. Those matters therefore fall to be considered as well;

d) Finding that the claimed invention had not been anticipated through prior use, namely the trial by Cookson and Cornforth which led to the publication of their paper already referred to. In addition, subsequent to the hearing, Ballance obtained leave to argue prior use through the application of SupaCrop by a farmer, Mr Saunders;

e) Finding that the alleged invention was not obvious; and

f) Finding that the alleged invention was a proper subject matter for an invention within the meaning of s 2 Patents Act 1953.

[6] Ravensdown cross-appealed the Assistant Commissioner's decision as to the priority date for the purposes of prior use and prior publication. For the reasons I record later, Ballance accepted Ravensdown's argument on this issue.

[7] At the appeal hearing Ravensdown sought leave to cross-appeal against another of the Assistant Commissioner's findings and to support the decision on another ground. I allow these grounds to proceed. They relate to the finding at [89] that the common general knowledge at the relevant time included the fact that preventing the conversion of ammonium nitrogen to nitrate by the use of a nitrification inhibitor would decrease the diffusion of nitrous oxide into the atmosphere. Mr Miles QC, for Ravensdown, submitted that this finding was wrong because although it was common general knowledge that nitrous oxide emissions presented a problem, it was not known or thought that nitrification inhibitors could have any effect on those emissions. This issue was not raised in Ravensdown's notice of cross-appeal but I accept Mr Miles' submission that there would be no prejudice to Ballance because the very issue was specifically dealt with by one of its expert witnesses, Dr Edmeades, in new evidence adduced after the notice of cross-appeal had been filed.

[8] The application for leave to support the decision on another ground was based on the claim that the prior art had not dealt with nitrous oxide emissions and pasture growth. The focus of the Assistant Commissioner's decision on prior publication was the application of a nitrification inhibitor to substantially the whole area of grazed pasture soil. There was no mention of the purpose of such application including reduction of nitrous oxide emissions and increasing pasture growth. Mr Miles submitted that these aspects had not been focused on before the Assistant Commissioner and became prominent as a result of Ballance's new evidence, particularly the evidence of a new witness, Mr Bell-Booth, as well as Dr Edmeades. These issues are the other side of the same coin I have dealt with in relation to amendment of the cross-appeal.

Principles to be applied on appeal

[9] An appeal from any decision of the Commissioner following opposition to a patent claim is brought under s 21(5) Patents Act 1953, which confers a general right of appeal. The approach to be taken on such an appeal is explained in *Austin Nichols*

Inc v Stichting Lodestar.[4] It is for Ballance on the appeal and Ravensdown on the cross-appeal to satisfy the Court that the Assistant Commissioner's decision was wrong. In that event, the parties are entitled to a fresh assessment by this Court.

[10] In considering whether the Assistant Commissioner's decision was wrong, it must be remembered that the opposition procedure is not intended to finally dispose of truly contentious cases; that is the purpose of a revocation action under s 41. The significance of this difference was explained by Buckley LJ in *Dunlop Holdings Ltd*:[5]

> It is a peculiar feature of opposition proceedings that, if opposition fails, the opponents are not at the end of the road; they still have an opportunity, at a later date, to defeat the objective of the applicants in a revocation action under s 32 of the Act in High Court proceedings, with all the features of pleadings, discovery, oral evidence including cross-examination, appertaining to a High Court action. It has been frequently said that opposition proceedings are a device for weeding out patent applications which obviously could not survive a revocation action. This peculiar feature of opposition proceedings might, it seems to be, have a bearing upon the degree of certitude which the Comptroller should feel in opposition proceedings, but it remains true that the standard of proof is the civil standard and not the criminal standard.
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> If, on the assessment of all the evidence adduced, regarded in light of the civil standard of proof, the tribunal were to reach the conclusion that, if the application for a patent were dismissed, there would be a real risk that an injustice might be done by depriving the applicant of an opportunity to protect his right to the patent in a full scale revocation action in the High Court, it seems to me at least arguable that special weight should be given to that consideration by the tribunal hearing the opposition proceedings in considering what degree of certainty it should have in relation to the alleged grounds of opposition. It is for the tribunal hearing the opposition proceedings to determine, on the balance of probabilities, what degree of risk of that kind there is. I would think that that would be one of the circumstances that it would be proper for the tribunal to take into account in considering whether, on the balance of probabilities, the opponents have succeeded in making out their case.

[11] There is one ground of appeal that is not to be determined on the *Stichting Lodestar* approach. It is the ground relating to the amendments that Ravensdown was permitted to make to its complete specification. This ground involves an appeal against the exercise of a discretion and the Court will only intervene if it is shown that the Assistant Commissioner acted on a wrong legal principle, took account of

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[4] [2008] NZSC 103; [2008] 2 NZLR 141.
[5] [1979] RPC 523 at 544.

irrelevant matters, failed to take account of relevant matters, or was otherwise plainly wrong.[6]

Should the Commissioner have allowed amendments to the complete specification?

[12] Under s 38(1) Patents Act 1953 the Commissioner:

> May …allow the specification to be amended subject to such conditions, if any, as the Commissioner thinks fit.

[13] The power to allow amendment of the complete specification is subject to s 40(1) which limits the type of amendment that can be made to those made by way of disclaimer, correction or explanation. Further, except for correcting an obvious mistake, no such amendment can be allowed if its effect would be to broaden the scope of the specification.

[14] The Assistant Commissioner allowed several amendments to Ravensdown's complete specification. The amendments that are the subject of appeal were made to claims 1 and 18. They were that the treatment method which was initially said to "treat the area" was amended to read "to cover substantially the whole of the area". The amendments were reproduced in the decision in the following form:

> 1. A ~~soil management system~~ treatment method when used in pasture farming systems including an application of nitrification inhibitors in solution ~~form~~ and/or fine particle suspension form ~~and/or as a crystalline form~~ to ~~treat the~~ cover substantially the whole of the area including animal urine and non-urine patch areas of grazed pasture soil ~~so as~~ to reduce nitrate leaching; nitrous oxide emissions; potassium, calcium or magnesium leaching; and increase pasture production.
>
> 18. A method of improving pasture production in a grazed pasture by applying a nitrification inhibitor, the method including the step of applying the nitrification inhibitor in a solution and/or fine particle suspension form to treat substantially the whole ~~area~~ of the grazed pasture ~~soil~~ area including urine and non-urine patch areas to thereby reduce: (1) ~~NO_3^--N~~ nitrate leaching; (2) nitrous oxide emissions; (3) potassium, calcium or magnesium leaching in the grazed pasture.

[6] *Blackstone v Blackstone* [2008] NZCA 312.

[15] At [027] of his decision the Assistant Commissioner concluded that the amendments were by way of explanation or disclaimer:

> [I]t seems to me that in the context in which the word "substantially" is used in claims 1 and 18 it would be taken by the skilled reader to have the meaning given in the fourth entry in the Oxford English Dictionary online which reads "in all essential characters or features; in regard to everything material; any essentials; to all intents and purposes; in the main". This amendment to claims 1 and 18 can thus, as I understand it, be considered to be an amendment by explanation or, at least in the case of claim 1, by disclaimer – it restricts a non-specific statement "to treat the area including…" (which, as I read it, could mean the whole area of the pasture or a part thereof) to the treatment, for all practical purposes, of the whole pasture area.

[16] Ballance asserted that the Assistant Commissioner had proceeded on a wrong legal principle because the amendments did not fall within the grounds permitted by s 40(1). Mr Brown QC, for Ballance, submitted that the amendments were not by way of disclaimer, correction or explanation and resulted in the scope of the claim being increased. In particular, Mr Brown submitted that the term "substantially" means "in part" as opposed to "the whole". The effect of Mr Brown's submission was that a farmer treating only a small part of grazed pasture would not literally infringe the claim as it stood originally since doing so would not amount to treating "the area including animal urine and non-urine patch areas of grazed pasture soil". But once amended to require the nitrate inhibitor to cover "substantially the whole of the area including animal urine and non-urine patch areas of grazed pasture soil" the farmer who only treats part of his grazed pasture would infringe the claim.

[17] Mr Miles submitted that the amendment did not have that effect but was simply an explanation that a skilled addressee would read "treating the area" as involving, or, in practice, synonymous with "covering substantially the whole of the area". He said the amendment merely clarified and expressed this more clearly. Mr Miles suggested that the proper approach should be the purposive construction advocated in *Catnic Components Ltd v Hill & Smith Ltd*[7] rather than a literal one being suggested by Mr Brown.

[7] [1982] RPC 183; *Peterson Portable Sawing Systems v Lucas* [2006] NZSC 20 at [26].

[18] I accept Mr Miles' submission. As originally worded, the claim would, literally, have meant every portion of the area, but an amendment to "substantially the whole of the area" recognises the reality that small parts may be missed. The meaning of the claims in both the original and amended form is clearly that, as far as reasonably possible, the whole of the grazed pasture area should be treated. I do not see any error in the Assistant Commissioner's approach to the amendments.

The priority date

[19] Under s 21(1)(b) and (d) the Commissioner may refuse the grant of a patent application if the claimed invention has been published or used in New Zealand before the priority date of the claim. Under s 11(2), where there is a provisional specification followed by a complete specification, the priority date of the claim is the date the application was filed, provided the claim is fairly based on the matter disclosed in the provisional specification. Otherwise the priority date is the date of the complete specification.

[20] Ravensdown filed its provisional specification on 2 August 2002 and maintained that this was the priority date. However, the Assistant Commissioner held that the priority date was 1 August 2003, being the date Ravensdown filed its complete specification. This finding meant that Ballance could rely on a publication or use occurring before 1 August 2003. Ravensdown cross-appealed this finding.

[21] In considering this issue the Assistant Commissioner referred, correctly, to the test in *Mond Nickel Company Ltd's Application* for determining whether a complete specification is fairly based on a provisional specification:[8]

> It seems to me that there is a threefold investigation which is called for. Firstly, one has to enquire whether the alleged invention as claimed can be said to have been broadly described in the provisional specification and only if an affirmative answer is given to that question does one proceed to the second question, which is: Is there anything in the provisional specification which is inconsistent with the alleged invention as claimed? If it is found, upon examination, that the invention as characterised in the claim includes something which is inconsistent with that which is described in the provisional specification, as at present advised I should think that it would be

[8] [1956] RPC 189 at 194.

> right to conclude that that claim could not have been fairly based upon the disclosure; but, assuming that those two burdens are satisfactorily surmounted there is, I think, a third matter for enquiry: Does the claim include as a characteristic of the invention a feature as to which the provisional specification is wholly silent?

[22] The Assistant Commissioner concluded that the complete specification was not fairly based on the provisional specification. It is apparent from [037] – [049] of his decision that the basis for this conclusion was a belief that one of the features contained in the complete specification was not included in the provisional specification. This was the reduction of potassium, calcium, and magnesium leaching (known as cation leaching).

[23] It was agreed that the provisional specification did not refer to the reduction of cation leaching whereas this feature was specifically referred to in the complete specification. However, Mr Miles submitted that the Assistant Commissioner failed to take into account evidence that it was a matter of common general knowledge that leaching of nitrate ions and ammonium ions (which are negatively charged) is inevitably accompanied by the leaching of positively charged cations such as calcium, potassium and magnesium. Therefore, the reference to nitrate leaching carried with it implicit reference to cation leaching.

[24] At the conclusion of the hearing before me Mr Brown accepted that this effect was a well-known part of the nitrogen cycle and that Ballance did not resist the cross-appeal. The effect of this concession is that this ground of the cross-appeal is allowed and I proceed on the basis that the priority date is 2 August 2002, the filing date of the provisional specification.

Did the Assistant Commissioner err in his identification of the skilled addressee?

Relevant principles

[25] In *Catnic Components Ltd v Hill & Smith Ltd* Lord Diplock described a patent specification as:[9]

[9] [1982] RPC 183 at 242.

> [A] unilateral statement by the patentee, in words of his own choosing, addressed to those likely to have a practical interest in the subject of his invention (i.e. "skilled in the art"), by which he informs them what he claims to be the essential features of the new product or process for which the letters patent grant him a monopoly.

[26] The knowledge of a person "skilled in the art" is discovered through the mechanism of the skilled addressee, a hypothetical character, also known as the reader skilled in the art and other similar appellations. That knowledge is central to the determination of both anticipation and obviousness.

[27] What the skilled addressee is taken to know in any particular case is invariably determined with the assistance of expert evidence. However, the Commissioner or the Judge undertaking this assessment must be alert to the danger of equating a particular live expert witness with the hypothetical skilled addressee because, as described by Jacob LJ in *Technip France SA's Patent* the function of expert witnesses in patent actions is to educate the Court in the technology.[10] The use of a hypothetical figure recognises the fact that Judges are invariably reliant on expert evidence to determine what is known or obvious at the relevant date.[11]

[28] The main functions of the skilled addressee were identified by Lewison J in *Cranway Ltd v Playtech Ltd & Ors*:[12]

> [T]he skilled addressee has three main functions to perform in a case like this. First, it is through his eyes that the Court must interpret the patent in suit. Second, it is through his eyes that the Court must decide what is disclosed by any cited piece of prior art. Third, it is with his knowledge that the Court will decide whether the claimed invention of a patent in suit is obvious over common general knowledge or a cited piece of prior art. The skilled addressee may be a single person or a team. Usually the parties have little difficulty in identifying who the skilled addressee is or, in the case of a team, who constitute the members of the team.

[29] The characteristics of the skilled addressee are helpfully described by Laddie J in *Pfizer Limited's Patent*:[13]

> The question of obviousness has to be assessed through the eyes of the skilled but non-inventive man in the art. This is not a real person. He is a

[10] [2004] RPC 46.
[11] *A B Hassle v Alphapharm* (2000) 56 IPR 225 at [70], per Kirby J.
[12] [2009] EWHC 1588 (PAT).
[13] [2001] FSR 201.

> legal creation. He is supposed to offer a subjective test of whether a particular development can be protected by a patent. He is deemed to have looked at and read publicly available documents and to know of public uses in the prior art. He understands all languages and dialects. He never misses the obvious nor stumbles on the inventive. He has no private idiosyncratic preferences or dislikes. He never thinks laterally. He differs from all real people in one or more of these characteristics. A real worker in the field may never look at a piece of prior art – for example, he may never look at the contents of a public library – or he may be put off because it is in a language he does not know. But the notional addressee is taken to have done so. This is a reflection of part of the policy underlining the law of obviousness. Anything which is obvious over what is available to the public cannot subsequently be the subject of valid patent protection even if, in practice, few would have bothered looking through the prior art or would have found the particular items relied on. Patents are not granted for the discovery and wider dissemination of public material and what is obvious over it but only for making new inventions. A worker who finds, is given or stumbles upon any piece of prior art must realise that that art and anything obvious over it cannot be monopolised by him and he is reassured that it cannot be monopolised by anyone else.

Error in the identification of the skilled addressee?

[30] Mr Brown submitted that the Assistant Commissioner simply preferred Ravensdown's witnesses over Ballance's witnesses rather than using the expert evidence to identify the characteristics and knowledge of the hypothetical skilled addressee and wrongly accepted the opinions of Ravensdown's experts without considering the reasons for them, effectively equating the live witnesses with the hypothetical skilled addressee. In particular, Mr Brown submitted that the Assistant Commissioner wrongly treated the Ravensdown witness, Dr Baars, as more closely representing the skilled addressee in this case than the Ballance witnesses, Professor Cornforth and Dr Quin, because their background was more academic than that of Dr Baars.

[31] Mr Brown pointed particularly to [087] and [088] as evidencing the Assistant Commissioner's error:

> [087] Mr Miles submitted that the skilled addressee would most likely be a person involved in research in the agricultural sector, have experience in environmental issues, have knowledge of soil chemistry and biology and be involved in the farming community. In his submission Dr Baars fits that description.

> [088] It seems to me that Dr Baars is certainly a skilled person with a practical interest in the invention but so too are the Opponent's witnesses Professor Cornforth (who, before his retirement in 2004, had a long and distinguished career as a soil scientist working for Government and academic institutions) and Dr Quin (a former soil scientist and founder and currently Managing Director of Summit QuinPhos NZ Ltd), who have both given evidence on behalf of the Opponent, on the "common general knowledge" of the skilled addressee. It could perhaps be assumed however that Professor Cornforth and Dr Quin have had more academic careers than Dr Baars and are further removed from contact with the everyday farming community and the practical problems associated with the treatment of pastures.

[32] The starting point in a consideration of the skilled addressee in any case is to identify the attributes of the skilled addressee in the particular case. The Assistant Commissioner's comments at [088] indicated his view that the skilled addressee would be a person with knowledge of and interest in practical farming problems, which led him to prefer Dr Baars over those with a more academic background such as Professor Cornforth and Dr Quin.

[33] Mr Brown submitted that the area of the patent, being the development of a soil treatment method for pasture farming, is a highly technical field and has many parallels with the pharmaceutical field. He submitted that it relied, on a daily basis, on scientific endeavour through recalling observations, interpreting observations to determine relevant characteristics and designing systems based on those experimental observations. Mr Brown was critical of the Assistant Commissioner's apparent preference for knowledge of practical farming problems over academic experience. Mr Miles submitted, however, that the skilled addressee would most likely be a person interested in research in the agricultural sector with experience in environmental issues, knowledge of soil chemistry and biology, and be involved in the farming community. He recognised that the skilled addressee could be either an individual with all of these attributes or a team which together offered these attributes.

[34] It is apparent that the end users of the claimed invention will be farmers. However, it is equally clear that many, if not a majority, of farmers will look to those with qualifications and experience for advice on the usefulness of the claimed invention. It is evident from the affidavits of Dr Edmeades, for example, that farm consultants have a significant part to play in the adoption of the claimed invention by

the farming community. This means that the skilled addressee in this case needs to be a person with the knowledge and experience to adequately assess and advise farmers on the use of the Ravensdown method. It is therefore to be expected that the skilled addressee will hold academic qualifications in the area of soil chemistry and biology. However, a purely academic background or qualification would not suffice and the Assistant Commissioner was right to identify as a necessary attribute, knowledge of practical farming methods and problems.

[35] I agree that the Assistant Commissioner's statements at [087] and [088] do suggest that he was seeking to equate one or more of the witnesses with the skilled addressee. However, it is clear from his discussion at [089], in which he identifies the common general knowledge of the skilled addressee that, ultimately, he did not do that; he specifically referred to having studied the evidence of all of the above witnesses (that is, Dr Baars, Professor Cornforth and Dr Quin) which indicates that he did not, in fact, exclude the knowledge and experience offered by Professor Cornforth and Dr Quin in his assessment of the skilled addressee's knowledge. I therefore find no error in this aspect of the approach taken to the expert evidence.

[36] Mr Brown also criticised the Assistant Commissioner's approach to the expert witness evidence, submitting that the Assistant Commissioner failed to properly consider the reasons for the opinions offered by Ravensdown's experts. This relates specifically to the ground of obviousness and I deal with it when I come to consider obviousness.

Other aspects of expert evidence

[37] Before I leave the topic of expert evidence I need to deal with the allegations of lack of objectivity made by each party about the other's expert witnesses.

[38] First, Mr Brown submitted that the Assistant Commissioner erred by giving undue weight to the evidence of Professor Cameron, given that Professor Cameron is one of the named inventors of the patent application and, as an employee of one of the patentees, has a vested interest in the patent being granted. Conversely, Mr Miles pointed out Dr Quin's own financial interest in the fertiliser market;

although Dr Quin has no financial interest in Ballance, he has had a long involvement with Summit-Quinphos (NZ) Ltd which competes directly with both Ravensdown and Ballance in the New Zealand fertiliser market. Professor Cornforth's work was instigated by Dr Quin who retained him to undertake the trials that were reported in the Cookson and Cornforth paper.

[39] Out of caution it would have been desirable for the Assistant Commissioner, when preferring Professor Cameron's evidence to that of Professor Cornforth or Dr Quin, to have referred to the personal interest that Professor Cameron had in the claimed invention. Although Professor Cornforth's involvement had its roots in his contract with Dr Quin, Professor Cameron's interest is, undeniably, current and more direct. That is a matter which has relevance in assessing the evidence. It did not, however, preclude the acceptance of Professor Cameron's evidence over that of Professor Cornforth and the question must only be whether the Assistant Commissioner's preference for the evidence of Professors Cameron and Di was justified, even allowing for Professor Cameron's interest in the patent.

[40] Secondly, Ravensdown alleged bias against Dr Edmeades. Dr Edmeades stated that his evidence was based on his knowledge of nitrification inhibitors up to 2 August 2002 and that he had not taken into account knowledge he had gathered about them after that date. He gave no indication about the kind of knowledge he had obtained after that date and, in fairness, such information was strictly irrelevant to the issue of anticipation in the form of publication of the SupaCrop brochure. However, subsequent evidence from Ravensdown disclosed an association between it and Dr Edmeades between 2005 and 2008.

[41] Dr Edmeades had produced a report on nitrification inhibitors for Environment Waikato and Environment Bay of Plenty. He concluded that there was insufficient science to support the use of Eco-N, the Ravensdown product marketed following the completion of Professors Cameron's and Di's research. Ravensdown approached Dr Edmeades to develop a trial protocol to quantify the effect of Eco-N on pasture production so as to address the criticisms raised by Dr Edmeades in his reports. However, Ravensdown was dissatisfied with Dr Edmeades' approach to trial data and upset that he provided a copy of his draft report to Ballance. In

addition, Dr Edmeades made public statements to the effect that Eco-N had not been shown to improve pasture growth. For his part, Dr Edmeades maintains that his criticisms of Ravendown and Eco-N have been no more than legitimate comment in his capacity as an independent scientist and do not justify the claim of bias.

[42] Given the fraught end to the relationship it was inevitable that Dr Edmeades' failure to mention it would draw criticism. It would have been prudent for him to have acknowledged the association. However, I have found it unnecessary to make any finding in relation to the allegations of bias in determining the competing arguments.

Prior publication

[43] Under s 21(1)(b) the grant of a patent may be opposed on the ground that the invention has been published in New Zealand before the priority date. The priority date of 2 August 2002 left three publications asserted by Ballance as prior publications for the purposes of s 21(1)(b). These were the entry in the 1999 NZ Agrichemical Manual for a proprietary form of DCD, the abstract of a paper by Cookson and Cornforth which was published online in June 2002 and the promotional brochure for a fertiliser, SupaCrop, published in July 2002.

Relevant principles

[44] Determining whether an invention has been anticipated by an earlier publication requires comparison between the claimed invention and the prior publication. Under this test the starting point is to identify the common general knowledge in the area of soil treatment as at the dates of the earlier publication and the priority date. That is a question to be determined through the eyes of the skilled addressee.[14]

[14] *General Tire Rubber Company v The Firestone Tire & Rubber Company* [1972] RPC 457 at 485-486 (reversed by the House of Lords on other grounds), applied in New Zealand in *Peterson Portable Sawing Systems Ltd (in liquidation) v Lucas* [2006] NZSC 20.

[45] It is then for the Court to decide, as a question of fact, whether the claimed invention is new, by reference to the "reverse infringement" test set out by Sachs LJ in *General Tire Rubber Company v The Firestone Tire & Rubber Company*:[15]

> The earlier publication and the patentee's claim must each be construed as they would be at the respective relevant dates by a reader skilled in the art to which they relate having regard to the state of knowledge in such art at the relevant date. The construction of these documents is a function of the court, being a matter of law, but since documents of this nature are almost certain to contain technical material, the court, must by evidence, be put in the position of the person of the kind to whom the document is addressed, that is to say, a person skilled in the relevant art at the relevant date.....
>
> When the prior inventor's publication and all the patentee's claim have respectively been construed by the Court in the light of all properly admissible evidence as to technical matters, the meaning of words and expressions used in the art and so forth, the question whether the patentee's claim is new for the purposes of s 32(1)(b) falls to be decided as a question of fact. If the prior inventor's publication contained a clear description of, or clear instructions to do with or make, something that would infringe the patentee's claim if carried out after the grant of the patentee's patent, the patentee's claim will have been shown to lack the necessary novelty, that is to say, it will have been anticipated. The prior inventor, however, and the patentee may have approached the same device from different starting points and may for this reason or it may be for other reasons, have so described their devices that it cannot be immediately discerned from a reading of the language which they have respectively used that they have discovered in truth the same device; but if carrying out the directions contained in the prior inventor's publication will inevitably result in something being made or done which, if the patentee's patent were valid, would constitute an infringement of the patentee's claim, this circumstance demonstrates that the patentee's claim has in fact been anticipated.
>
> If, on the other hand, the prior publication contains a direction which is capable of being carried out in a manner which would infringe the patentee's claim but would be at least as likely to be carried out in a way which would not do so, the patentee's claim will not have been anticipated, although it may fail on the ground of obviousness. To anticipate the patentee's claim the prior publication must contain clear and unmistakable directions to do what the patentee claims to have invented…A signpost, however clear, upon the road to the patentee's invention will not suffice. The prior inventor must be clearly shown to have planted his flag at the precise destination before the patentee.

[15] [1972] RPC 457 at 485-486

The state of common general knowledge prior to 2 August 2002

[46] At [089] the Assistant Commissioner identified what he considered to be the relevant common general knowledge held by the skilled addressee at the priority date as being:

- The nitrogen loading on New Zealand soils, including that caused by the urination of grazing animals, was having an environmental impact, including nitrate leaching into drainage water and diffusion of gaseous forms (such as nitrous oxide, a greenhouse gas) into the atmosphere.

- Preventing the conversion of ammonium nitrogen to nitrate by the use of a nitrification inhibitor would decrease the nitrate loss by leaching and decrease the diffusion of nitrous oxide into the atmosphere.

- Nitrification inhibitors (such as DIDIN or DCD) could be applied with the nitrogen source (such as nitrogenous fertiliser) or by application directly to urine patches (for example, by devices which attach to animals and are activated by their urination).

[47] Three aspects of common general knowledge as found by the Assistant Commissioner are in issue. The first is whether it was known that DCD could reduce nitrous oxide emissions; Mr Miles submitted that the Assistant Commissioner was wrong to conclude that it was common general knowledge that the use of a nitrification inhibitor could reduce the diffusion of nitrous oxide into the atmosphere. He said that, although it was known that nitrous oxide emissions were a problem, it was not known that DCD could reduce such emissions. He also submitted that the Assistant Commissioner's reference to the use of nitrification inhibitors to decrease nitrogen loss by leaching should have been qualified by reference to the common view that this use was not considered to be a viable option. Witnesses for Ballance asserted, however, that it was known before 2002 that DCD could reduce nitrous oxide emissions.

[48] The second issue is whether it was known that DCD could be applied alone over the whole of a grazed pasture. It is evident from the Assistant Commissioner's

conclusions that he did not consider that general application of a nitrification inhibitor alone formed part of the common general knowledge, since it is not referred to as doing so. Ravensdown maintained that this method of application was not contemplated prior to August 2002. Witnesses for Ballance, however, asserted that the concept of widespread application of DCD to pasture on its own was known before 2002.

[49] The third issue was whether it was known that DCD applied over the whole of a grazed pasture would increase pasture growth. Ravensdown said that this was not known. Evidence from Ballance on this point was inconsistent.

[50] Professor Cornforth, giving evidence for Ballance about the state of his knowledge in August 2002, described early research regarding the process of nitrification and said that:

> [I] knew that nitrous oxide, a greenhouse gas which is also responsible for depleting the concentration of ozone in the upper atmosphere, was produced in soils as a bi-product of nitrification and by the reduction of nitrate-N in waterlogged soils.
>
> From this information it is logical to conclude that nitrification inhibitors, by preventing the formation of nitrate-N would decrease nitrate leaching, the associated loss of basic cations and the formation of nitrous oxide in soils. These conclusions have been verified experimentally during the last twenty years.
>
> I also knew that, in some circumstances, nitrification inhibitors could increase plant growth but that research had demonstrated that the occurrence and scale of such a response was difficult to predict…
>
> I knew that dicyandiamide was an effective nitrification inhibitor, that it was cheap enough for routine and widespread use, was safe and easy to apply and that it decomposed in the soil to produce harmless residues…Dicyandiamide has been proved to be effective when applied with ammonium or urea fertilisers, dissolved in organic slurries and waste waters or added directly to cattle urine…
>
> I knew that nitrification inhibitors including DCD, DNPP or nitrapyrin (all well known prior to August 2002) could be applied to pasture, including the whole pasture (whether grazed or ungrazed) and whether having urine spots or not, in the same way as any other agri-chemical including in solution or suspension form (on their own or in conjunction with some other liquid including water or effluent), suspensions including fine particle suspensions (all suspensions involve fine particles) or in crystallised/powdered form…

[51] Professor Cornforth concluded that:

> I knew that by manipulating:
>
> (1) The quantity of nitrification inhibitor applied to the pasture; and
>
> (2) How, in what form and when it was applied;
>
> A farmer could attempt to decrease loss of nitrates, nitrous oxide, potassium, calcium and magnesium and/or seek to increase pasture production.

[52] However, Professor Cornforth's summary, which effectively reflects the claimed invention, was not supported by any specific source of knowledge. The only reason he gave for such knowledge of application of DCD alone to the whole pasture was promotional material (now lost) relating to the purchase in 1999 of DCD from Fertimex. Presumably this was the product DIDIN (the subject of the entry in the NZ Agrichemical Manual, which is relied on as as prior publication). But all that Professor Cornforth was able to say was that "this material described the ability of DCD to inhibit nitrification and suggested application rates". This falls well short of evidencing a basis for knowledge that DCD could be applied generally to the soil for the purpose of reducing nitrate/cation leaching and nitrous oxide emissions and increasing pasture growth.

[53] In relation to the use of DCD by the Ravensdown method to increase plant growth, Professor Cornforth offered no detail as to the basis for his claim that he knew of this purpose. The reference to the inconsistent results of research on this point means that this claim can be given little weight.

[54] Professor Cornforth's evidence was supported by the evidence of Dr Quin, who has a strong interest in the issue of nitrate leaching and has, himself, applied for a patent for a device which is attached to grazing animals and dispenses nitrification inhibitor when the animal lifts its tail to urinate. Dr Quin's evidence as to the state of common general knowledge at the time included that:

> Prior to August 2002 it was well known that the major source of N loss from grazed pastures was as nitrate leached from urine patches…
>
> It was clearly understood by soil scientists that if a nitrification inhibitor was applied directly to a grazed pasture instead of to a fertiliser or added to effluent about to be applied to the land it would have its greatest effect on reducing nitrate leaching on those parts of the soil where urea and/or ammonium-N levels were highest, that is, in urine patches. The only reason in my view why this has not been practised commercially before was that the

> use of DCD to treat the entire pasture was not considered economic prior to 2002. High produce prices in recent years have increased the profitability of boosting growth with N fertiliser and hence the potential profitability of using products such as DCD to improve the recovery of any N in the system. As I have already said DCD is not just a nitrification inhibitor; it is a slow-release N fertiliser in its own right, albeit an expensive one. Over a period of a few weeks it is decomposed in the soil into smaller molecules, eventually urea itself (Amberger 1989). Therefore, there is no difference in principle to using DCD as a (solid or spray) treatment for pasture directly and the already well established use of DCD to treat urea fertiliser before it is applied to pasture – the difference is only in the degree of N fertiliser being applied i.e. relying on the fertilising effect of the DCD itself or adding additional fertiliser N.

[55] Dr Quin summarised the state of knowledge in New Zealand before August 2002. This included that:

- The application and use of nitrification inhibitors on soil used for growing crops and/or pasture could:
  - reduce nitrate leaching and thereby reduce leaching of potassium, calcium and magnesium; and
  - increase pasture production.

- Nitrification inhibitors, including DCD, DNPP or nitripyrin (all well known prior to August 2002) could be applied to pasture, including the whole pasture (whether grazed or ungrazed) and whether having urine spots or not, in the same way as any other agri-chemical including in solution or suspension form (on their own or in conjunction with some other liquid, including water or effluent), suspensions including fine particle suspensions or in crystallised/powder form.

- By manipulating the quantity of nitrification inhibitor applied to the pasture and how, in what form and when it was applied, the farmer could alter the rate of reduction of losses of nutrients and/or increase pasture production.

[56] A Ravensdown witness, John Russell, challenged Dr Quin's claim that it was known that a nitrification inhibitor could be effectively applied directly to grazed soil instead of fertiliser and was only not done before 2002 because it was not considered economic. Mr Russell is the Environmental Technical Manager for

Fonterra Co-operative Group Limited. He has worked in the dairy industry since 1993 and has particular research functions relating to the application of high-strength wastes to land, nutrient cycling and biological treatment of greenhouse emissions including nitrous oxide. In relation to the use of a general application of DCD Mr Russell said that:

> To my knowledge no-one suggested applying dicyandiamide in a widespread manner prior to the disclosures made by Ravensdown and Lincoln University. In fact, other recent developments in New Zealand appear to be directed towards apply dicyandiamide with the urine (e.g. the patent number 506883 developed by Dr Quin and the development of a bolus by AgResearch to slow release dicyandiamide into the animal so that it is deposited with urine). These are very different directions to that of this patent.

[57] In relation to the previous publications relied on by Dr Quin, Mr Russell observed that they targeted the fertiliser or contaminant by applying the inhibitor with the fertiliser or contaminant, a fundamentally different approach to that of the Ravensdown method, which targets the soil.

[58] In response, Dr Quin maintained that Turner and McGregor (1978) did investigate the use of nitrification inhibitor by itself and the plots they used, from previously grazed pasture, would necessarily have contained some residual urine of varying ages. He also maintained the relevance of the Williamson and Jarvis (1997) work because mixing DCD with urine produces no different effect than if applied separately. However, Mr Russell noted that the Turner and McGregor paper specifically observed that "under field conditions the control of nitrification was of limited duration and did not increase pasture production or recovery of applied fertilier-N". This is contrary to Dr Quin's claim that increased pasture production was a known effect of nitrification inhibitors. I note that the Turner and McGregor paper was not referred to at all by Professor Cornforth.

[59] Professor Cameron, for Ravensdown, gave evidence consistent with that of Mr Russell, pointing out that the purpose of the Turner and McGregor paper appeared to be directed at improving nitrogen recovery from fertilisers using a nitrification inhibitor; there was no mention of urine in the entire article.

[60] The evidence from Professors Di and Cameron was that prior to August 2002 there was no recognition that DCD could usefully be applied alone to pasture, nor that such application could reduce nitrous oxide emissions and increase pasture growth as well as reduce nitrate/cation leaching. Both asserted that the general application of DCD to grazed pasture had not been considered prior to their research; previously the focus had been on treating the nitrogen source itself rather than the soil into which the nitrogen would be placed.

[61] Professor Cameron observed that most of the prior art in the area of nitrification inhibitors was developed overseas where animals are usually housed indoors for some or all of the year and the source of nitrogen pollution comes mainly from animal manure that is collected and then applied to the soil. In New Zealand, however, nitrate leached from animal urine on grazed pasture represents most of the nitrogen leached from the paddock. Professor Cameron commented that:

> There has therefore been less need for overseas researchers to invent a method of reducing nitrogen losses from animal urine deposit in grazed pasture soil as described in NZ520549. I believe that there is a critical distinction between the prior art involving the use of a nitrification inhibitor in conjunction with the nitrogen source that is being applied to the soil compared to our invention involving the treatment of the soil itself which has either received or will subsequently receive the nitrogen source…
>
> Despite the fact that the effect of nitrification inhibitors on reducing the rate of conversion of ammonium to nitrate and thus the potential to reduce nitrate leaching was known prior to August 2002 I do not believe that the method of treating substantially the whole area of grazed pasture soil itself which has either received or will subsequently receive the nitrogen source was described or used prior to August 2002. Earlier work involved the application of an inhibitor with fertiliser or stored animal effluent to reduce the losses from the specific N sources.

[62] Richard Christie gave similar evidence. Mr Christie is the General Manager of Strategic Development of Ravensdown and has had more than 20 years experience in the agricultural industry, of which 15 have been specifically related to the fertiliser industry. He described a low level of knowledge about and use of nitrification inhibitors prior to August 2002:

> The most likely market for nitrification inhibitors in New Zealand prior to August 2002 was in intensive cropping or horticulture,with inhibitor-coated nitrogen fertilisers. However, with the possible exception of the brief availability of DIDIN no products were in commercial use.

[63] Mr Christie also drew attention to the apparent inconsistency between Professor Cornforth's statement that prior to 2002 DCD was cheap enough for routine and widespread use and Dr Quin's suggestion that prior to 2002 it was not regarded as economic to apply DCD to the whole pasture. Mr Christie's evidence was that because the benefits of general application of DCD were not fully understood no assessment could be made about whether such use was economic (implying that no such assessment had been made). Mr Christie also noted that (contrary to Dr Quin's claim that DCD is a fertilier in its own right) its cost at over $6/kgN was so much more expensive than urea at less than $1.10/kgN that it would be prohibitively expensive for use as a fertiliser. No other witness suggested that it was known before August 2002 that DCD could be effective applied to the whole of pasture on its own.

[64] The overall effect of the evidence, in my judgment, is that prior to August 2002 the effect of DCD as a nitrification inhibitor was known within the soil science and farming communities but its application was invariably associated with the application of fertiliser or effluent. There is no evidence that general application of it alone was regarded as either useful or economic. The various pieces of knowledge referred to by Professor Cornforth and Dr Quin do not reflect an appreciation prior to August 2002 that general application of DCD to grazed pasture was, in itself, effective in reducing nitrate/cation leaching and nitrous oxide emissions. Nor was it known (or even thought) that increased pasture production would result from this kind of application. In fact, work done up till then suggested that it would not. Against this conclusion as to the state of common general knowledge I turn to consider the three publications relied on by Ballance as prior publications for the purpose of s 21(1)(b).

The NZ Agrichemical Manual (DIDIN)

[65] The 1998/99 NZ Agrichemical Manual contained an entry for DIDIN, the proprietary name for a nitrogen inhibitor with the active ingredient dicyandiamide. The entry stated:

> DIDIN Nitrogen Inhibitor

> PRODUCT BRIEF
>
> DIDIN slows down the transformation of urea and ammonium nitrogen, usually applied in fertiliser and effluent, to nitrate nitrogen. This reduces leaching losses and excessive nitrate levels in crops. Particularly important where high nitrate levels are a problem or where a single application of nitrogen fertiliser is expected to supply nitrogen throughout the crop's growing cycle
>
> Active ingredient: Dicyandiamide
>
> Mode of action: DIDIN inhibits the activity of nitrosoma soil bacteria, slowing down the rate at which nitrates are formed from ammonium nitrogen.
>
> RECOMMENDED USES
>
> Maize, wheat, potatoes, pasture, vegetables
>
> Apply at 5-10% of ammonium nitrogen content of the fertiliser to be used. For example, where urea is applied at 100 kg/ha (ammonium nitrogen content 46 kg/ha), the amount of DIDIN used should be 2.3-4.6 kg/ha. Mix with water and spray on the soil or mix in with effluent, if effluent is to be applied.

[66] Assistant Commissioner Popplewell dealt with this document by referring solely to the evidence of Professors Cornforth and Cameron. Professor Cornforth considered that the DIDIN entry:

> [D]escribes a nitrification inhibitor that can be added to water and spread on the whole of the pasture. Whether DIDIN is present in the solute in solution or as a fine particle suspension is merely dependent on the concentration of DIDIN in the solute.

[67] Professor Cameron's response was that:

> [I]n my view it is very clear [the document] cannot disclose the invention of NZ520549 as it is claimed. It simply describes an application of DIDIN in association with fertiliser or effluent (either mixed with the nitrogen source or applied alone) in order to reduce nitrate leaching from the fertiliser or effluent nitrogen applied. It does not recognise animal urine patches as a problem for nitrate leaching or nitrous oxide emissions. It does not provide a method for treating grazed pasture soils, including urine and non-urine patch areas to derive the benefits of not only reduced nitrate leaching, but also reduced cation leaching, reduced nitrous oxide emissions and increased pasture production. The last three benefits were not recognised in [the] document…Neither does the document describe the amount, timing and frequency of DIDN application for optimal effectiveness to treat the urine and non-urine patch areas. This new information was only disclosed after the publication of NZ520549. [The] document…is a further example of the viewpoint commonly held in New Zealand, prior to publication of our

> invention, that nitrification inhibitors should be used to treat fertilier or effluent nitrogen sources.

[68] Assistant Commissioner Popplewell said:

> [056] I agree with Professor Cameron. For example, the cited document does not specify that the nitrification inhibitor (DIDIN in this case) is applied "to cover substantially the whole of the area…of grazed pasture soil" and it is clear that the "prior inventor" has not been "clearly shown to have planted his flag at the precise destination before the [applicant]".

[69] Mr Brown submitted that the manual clearly recommended the application of DIDIN to pasture and, in doing so, taught the application of DIDIN to cover substantially the whole of the area of grazed pasture soil. Mr Brown pointed out that, not only did the manual recommend the application of DIDIN to pasture as a recommended use, the application rates given at 2.3-4.6 kg/ha anticipated a wide coverage. Given that fact, and in the absence of any instruction to the contrary, the application of DIDIN to pasture as a recommended use should be read as meaning the whole of a pasture, there being no reason to read into the instructions a limitation to only part of a pasture.

[70] In further support of this assertion Mr Brown referred to the application instructions to "[m]ix with water and spray on the soil or mix in with effluent, if effluent is to be applied". He suggested that effluent is applied to the whole of a pasture, not to selective portions. In making this submission, Mr Brown was critical of Professor Cameron's evidence that the manual "simply describes an application of DIDIN in association with fertiliser or effluent (either mixed with the nitrogen source or applied alone)".

[71] Mr Brown's submissions built to the general submission that following the application instructions in the manual would inevitably lead to the claimed invention, namely application of a nitrate inhibitor to the whole of a pasture including both urine and non-urine patches, satisfying the reverse infringement test.

[72] Mr Miles submitted that use of DIDIN contemplated by the manual reflected the common general practice of the time which was to apply a nitrification inhibitor along with fertiliser or effluent so as to slow the loss of nitrogen from those sources

i.e. directing the DIDIN towards the source of nitrogen rather than the soil. He submitted that the manual did not teach the use of DIDIN to treat substantially the whole of the grazed pasture soil, did not teach its use for the purpose or increasing pasture production, did not teach its use for the purpose of reducing nitrous oxide emissions and did not teach its use for the combined uses of reducing nitrate and cation leaching as well as reducing nitrous oxide leaching and increasing pasture production.

[73] I consider that Mr Brown's submission regarding the application rates of DIDIN relied on only part of the recommendation taken out of context. Read as a whole, it is clear that the recommendation anticipates that DIDIN will be used along with fertiliser; the actual recommendation is for application at "5-10% of ammonium nitrogen content of the fertiliser to be used". The application rates relied on by Mr Brown were not general application rates, but rather application rates given as an example "where urea is applied at 100 kg/ha (ammonium nitrogen content 46 kg/ha). There is no recommendation given for the use of DIDIN alone, nor any advice regarding timing or frequency of such application.

[74] Mr Brown is correct that the effect of the recommendation would result in DIDIN being applied over the whole of a pasture, but that is no more than the consequence of applying it with fertiliser. The recommendation does not envisage general application of DIDIN directed to the soil, which is the significant difference claimed by Ravensdown.

[75] Further, I accept Mr Miles' submission that the manual does not teach the use of DIDIN for the purpose of increasing pasture production or reducing nitrous oxide emissions. Neither are even obliquely referred to. It is clear that the anticipated purpose is the reduction of nitrate (and, consequently, cation) leaching losses and excessive nitrate levels in crops. The purpose and recommended method of use of DIDIN contained in the manual very much reflected the then current state of common general knowledge that I have already discussed. A user of DIDIN relying on the manual would not apply it alone and would not apply it for the purpose of reducing nitrous oxide emissions or increasing pasture production. In this regard I note that, although the complete specification does not specify application rates, the

effect of the method is specified (i.e. to increase pasture production by specified percentages). Ravensdown witnesses asserted (without challenge) that the recommended rate of application of DIDIN would be insufficient to achieve the specified results. As a result, the DIDIN entry could not be said, within the meaning of the *General Tire* test, to have planted the flag precisely at the precise destination of the invention. This ground of appeal therefore fails.

The abstract of the Cookson and Cornforth paper

[76] The second instance of prior publication relied on by Ballance was the abstract of the Cookson and Cornforth paper published in the journal *Soil Biology and Biochemistry* in late 2002. The date of publication meant that the final paper was published after the priority date. However, an abstract and uncorrected proof of the paper was published online on 21 June 2002. Ballance argued that the content of the abstract was sufficient publication of the Ravensdown method.

[77] The abstract stated:

> Decreasing the production of nitrate
>
> This paper reports the effects of the nitrification inhibitor dicyandiamide (DIDIN) on NO_3^--N and ammonium-N:
>
> Decreasing the production of nitrate-N (NO_3^--N) in cattle urine patches may reduce the environmental impacts of pastoral agriculture. This paper reports the effects of the nitrification inhibitor dicyandiamide (DIDIN) on NO_3^--N and ammonium-N (NH_4^+-N) production, soil pH and pasture yield in urine-amended and control soil under field conditions. In control plots, DIDIN application did not affect NO_3^--N, NH_4^+-N, pH or pasture yields. In urine-amended plots, DIDIN application significantly (P<0.05) reduced peak NO_3^--N concentrations, the amount of NO_3^--N leached, hence decreasing the potential for denitrification losses. Conversely, soil NH_4^+-N concentration decreased more gradually when urine was amended DIDIN which increased the opportunity for greater immobilization to occur. Differences in NO_3^--N and NH_4^+-N concentration between urine-amended treatments were also reflected by increases in soil pH but not pasture yields.

[78] The abstract clearly does report on the use of DCD alone. It is not, however, directed towards the general application in both urine and non-urine patches of grazed pasture (as would result from the random deposits by animals). The application is clearly to urine patches with the comparison against controlled plots.

This is a fundamental difference from the claimed invention by Ravensdown. Secondly, the abstract conveys a negative conclusion regarding pasture yields following the use of DCD, also an important difference from Ravensdown's claimed invention. For these two reasons the abstract cannot be regarded as a prior publication for the purposes of s 21(1)(b).

The SupaCrop advertisment

[79] The third publication relied on by Ballance is an advertising brochure for a product with the trade name SupaCrop. The brochure was published in New Zealand from 22 July 2002. SupaCrop is described in the advertisement as "a concentrated and convenient source of fully soluble nitrogen [which]…also contains a stabilising agent, DICY, to prolong the availability of soil nitrogen reserves…a benefit which is supplementary to nitrogen fertiliser." It was common ground that DICY was a reference to DCD. The brochure contained the following statements:

> Liquid N is formulated as a foliar applied nitrogen fertiliser and for maximum absorption should be applied to plants with adequate foliage. It also contains a stabilising agent, DICY, to prolong the availability of soil nitrogen reserves, (see below), a benefit which is supplementary to nitrogen fertiliser.
>
> Liquid N may be applied to all crops including cereals, vegetables, pasture and horticultural crops during the early season to promote vigorous healthy growth. Liquid N can continue to be applied on those crops needing high levels of nitrogen throughout the seasons i.e. cereals, pasture, etc.
>
> Liquid N can be used by itself as a single element foliar fertiliser or blended with other water soluble NPKs, sulphur, magnesium and trace elements. It is compatible with most fertilisers and agricultural chemicals.
>
> Nitrogen stabiliser
>
> Liquid N contains a chemical stabiliser to prolong the field life of nitrogen in the soil. Nitrogen in the ammonia form derived from natural or fertiliser sources is virtually non-leachable in the soil. The ammonium nitrogen is converted to the more plant-available nitrate form by bacteria. Unfortunately in this form it is readily lost by leaching. Liquid N contains an inhibitor, DICY, that controls the bacterial activity so that ammonium conversion proceeds at a rate closer to plants requirements.
>
> DICY acts on both that portion of nitrogen from the liquid N that reaches the soil and more importantly on the residual ammonium nitrogen in the soil. This stabilising effect can last for up to four months in the soil…
>
> Crops

> Apply 5-10 litres/ha early in the season and 10-15 litres/ha when leaf coverage is maximised. For most crops application should stop after mid-season or excessive soft growth may occur and fruit quality reduced.
>
> Cereals and pastures
>
> Continue through the season to increase protein levels and yield. Application rates up to 40 litres/ha may be used if economic or required.
>
> Water rates
>
> Use 100 litres water for ground application and 25 litres water for aerial application.

[80] Ballance asserted that these statements demonstrate many of the same features claimed by Ravensdown in respect of its patented invention. In particular, Mr Brown argued that the SupaCrop brochure:

- Claimed that it prolonged the availability of soil nitrogen reserves
- Showed the use of DCD as a nitrogen inhibitor to control bacterial activity in the soil that would result in nitrification
- Instructed the use of DICY in a water solution
- Taught the application of DICY to pasture generally
- Claimed vigorous healthy growth as an effect
- Instructed application rates of up to 40 L/ha.

[81] Mr Brown also pointed out that, to the extent that the SupaCrop brochure advocated the application of DCD as a nitrification inhibitor, it could be taken to be referring also to the inevitable effects of nitrification inhibition; not only a decrease in nitrate leaching but also in nitrous oxide emissions. In addition, because such reductions lead to an increase in nitrogen in the soil which is taken up by the plants, the result is an increase in pasture production.

[82] Neither Professor Cornforth nor Dr Quin made any comment on the SupaCrop brochure. Instead, Dr Edmeades was introduced to comment on this

aspect of the case. Dr Edmeades pointed to the explicit statement that "DICY acts on both that portion of nitrogen from the liquid N that reaches the soil and, more importantly, on the residual ammonium nitrogen in the soil. This stabilising effect can last for up to four months in the soil". As Dr Edmeades points out, DCD acts on the nitrosomas bacteria in the soil, not on the nitrogen itself (in this respect the statement in the SupaCrop brochure is poorly worded). The operation of DCD on the nitrosomas bacteria must mean that the source of the nitrogen is irrelevant. Dr Edmeades must therefore be right in saying that the statement makes it clear that the nitrification inhibitor contained in SupaCrop will be effective for a period of up to four months, regardless of the source of the nitrogen.

[83] I do not, however, accept that the brochure conveys an intended use of DCD targeted primarily at the soil. The brochure specifies that SupaCrop is formulated as a "foliar-applied nitrogen fertiliser". Ravensdown contends that this description and the recommendation that the product be applied "when leaf coverage is maximised" makes it clear that SupaCrop is not intended for use on grazed pasture soil. Dr Edmeades, in response, pointed to the statement in the brochure just discussed and the recommendation that it is to be applied to pastures "with adequate foliage", asserting that a pasture with adequate foliage is no different to a grazed pasture. I consider that the Ravensdown approach is correct; grazed pasture is inherently less likely to contain substantial foliage. Whilst pasture will contain foliage, the recommendation that the product be applied when "leaf coverage is maximised" clearly conveys that the product is directed primarily to foliage rather than soil. In comparison, the Ravensdown method targets soil.

[84] There are also other aspects identified by Ravensdown which form part of the claimed invention and do not appear in the SupaCrop advertisement. The purpose of the nitrogen inhibitor is said to be prolonging the field life of nitrogen in the soil. Mr Miles submitted that the brochure does not refer to the use of a nitrogen inhibitor for the purpose of reducing nitrous oxide emissions. Dr Edmeades asserts that the brochure does include the reduction of nitrous oxide emissions as a benefit on the basis that the only mechanism by which nitrogen is lost other than nitrate/cation leaching is as nitreous oxide, so the phrase "reduces N losses" must include losses of nitrous oxide. This assertion was not accepted by Ravensdown's witnesses, who

pointed out that there are, in fact, other mechanisms by which nitrogen can be lost. Dr Edmeades' response was that losses from leaching of nitrogen are from both nitrates and gaseous forms of nitrogen, a fact which has been known for some time, and that there is no significance in the brochure not specifying all the different types of nitrogen lost.

[85] On this point I accept the position taken by the Ravensdown witnesses. The SupaCrop brochure is to be read against the state of knowledge that existed prior to August 2002. It is apparent from the evidence that the perceived benefit of nitrate inhibitors at that time was the reduction in nitrate/cation leaching and that is the only type of loss specifically referred to. There is no basis on which to read into the brochure an intention to refer to nitrous oxide emissions.

[86] Ravensdown also asserts that the SupaCrop brochure does not advocate as one of its purposes the increase of pasture production. I accept this. SupaCrop is predominantly a form of soluble nitrogen. It is clear from the statements in the brochure that it is this aspect of the produce which was being advanced as promoting plant growth including pasture growth. The nitrogen inhibitor DICY is added to the product to prolong the benefit of the nitrogen fertiliser but there is no suggestion that the makers of SupaCrop were advocating the use of DICY in itself as the effective agent in promoting plant growth. This ground of appeal therefore fails.

Prior use

[87] Under s 21(1)(d) a grant of patent may be opposed on the ground that the claimed invention was used in New Zealand before the priority date. Ballance asserts two instances of prior use. These were the use of DCD, first, by Mr Cookson and Professor Cornforth in the trial that led up to the Cookson and Cornforth paper and, secondly, by a farmer, Mr Saunders, on his farm.

Relevant principles

[88] "Use" for the purposes of s 21(1)(d) has a wide meaning; in *Bristol-Myers* Lord Diplock said that:[16]

> [I]t is, at any rate by now, clear law that prior use which defeats a patent need not be habitual – one single instance is enough: nor need it be for the purposes of trade if it is use from which the user derives a practical benefit.

[89] What constitutes a use for the purposes of s 21(1)(d) depends on the nature of the claimed invention; where the subject of the patent is a product use can include either the manufacture or sale or supply of the product. In this case, however, the claimed invention is a new way and purpose of using a well-known product. Use of this kind was considered by the House of Lords in *Boyce v Morris Motors Ltd* where the claimed invention was a novel use for the known integers of a thermometer and the cooling system of a motor vehicle, namely to allow the driver to see the temperature of the air space above the water in the radiator.[17] The alleged prior use was by Rolls Royce Ltd of thermometers in either the filler of the radiator or the cap of the radiator for the purposes of testing the performance of cars.

[90] In the Court of Appeal Astbury J observed that:[18]

> In none of these *Rolls Royce* tests was the Plaintiff's problem and its solution remotely realized or considered. The tests were for a wholly different purpose. No evidence was given was given that the thermometer readings were visible or intended to be visible to the driver.
>
> An incomplete experimental user which led only to partial success, even in the subsequent Patentee's field, would not amount to a disclosure of the subsequent perfected invention ...When a patent, especially one of a simple character, has proved commercial success, evidence of alleged prior user requires and ought to receive very careful scrutiny, and evidence of something that nearly, but not quite, a prior user is not relevant as such to an allegation of want of subject matter in a subsequent patent.

[91] This decision was upheld on appeal and cited with approval by Lord Diplock in *Bristol-Myers*:[19]

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[16] *Bristol-Myers Co v Beecham Group Ltd* [1974] AC 646; [1974] 1 All ER 333 at 352.
[17] (1927) 44 RPC 105.
[18] [1927] 44 RPC 105 at 134.
[19] [1974] FSR 43 at 67.

> In *Boyce's* case Astbury J had rejected the alleged prior use of the combination of well known integers, not on the ground that it was accidental but on the ground that it was a different use from that for which novelty was claimed in the specification. This was clearly right…

[92] If prior use were made out in this case, it would also be necessary to consider s 21(4), which provides that:

> [F]or the purposes of paragraph (d) or (e) of the said subsection (1) no account shall be taken of any secret use.

[93] In *Bristol-Myers Co (Johnson's) Application* the House of Lords decided that a secret use was one that was intentionally concealed.[20] This decision led to an IPONZ practice note in July 1980, the effect of which was to require an opponent to show, among other things, that the prior use asserted was not a secret use of the invention.

Use by Cookson and Cornforth in their trial

[94] Ballance's pleading before the Assistance Commissioner was limited to use of DCD by Fertimex (the distributor of DIDIN). But at the hearing it relied on the Cookson and Cornforth trial as the prior use and the Assistant Commissioner dealt with that issue without any amendment to the pleadings. Since Ravensdown's existing pleading accepted that Fertimex had used DCD but denied that was a public use Ballance proceeded on the assumption that, on appeal, that position would be maintained in relation to the asserted use during the Cookson and Cornforth trial. It therefore directed its submissions towards the issue of whether the use had been secret rather than whether it had been a use for the purposes of s 21(1)(d). However, the pleaded use by Fertimex (selling and offering to supply) was very different from the use in the Cookson and Cornforth trial and Ravensdown's evidence made it clear that it did not accept that the Cookson and Cornforth trial constituted such use. I therefore approach the question of prior use during the Cookson and Cornforth trial on the basis that both the nature of the use and whether it was a secret use are in issue.

[20] [1975] 92 RPC 127.

[95] Although Mr Brown accepted that the Cookson and Cornforth paper did not amount to a prior publication, he submitted that it was, nevertheless, evidence of prior use, namely the actual trial conducted by Mr Cookson and Professor Cornforth. I note, first, that Mr Brown did not seek to rely on Professor Cornforth's evidence as to what the trial had involved as evidence of prior use. However, Professor Cornforth's own affirmation is relevant and, indeed, the best evidence of the use to which he and Mr Cookson put DCD during the trial. Professor Cornforth said in his first affirmation that:

> We measured the effects of DCD on nitrification when applied to urine-treated field soils and to control areas which had not received urine. DCD was applied in aqueous solution at two rates. DCD decreased the nitrification of ammonium-N derived from urine and the amount of nitrate-N leached from the surface layers of soil, but had no effect on the rate at which the pasture plants grew. We found that the DCD activity declined 40 days after it was applied and that it was ineffective after 60 days. This indicated that DCD would have to be applied repeatedly to urine affected soils, the frequency depending largely on soil temperature.

[96] Although the trial did involve the application of DCD alone rather than in conjunction with a fertiliser (consistent with the Ravensdown method) this evidence otherwise describes a trial that focused on the effect of DCD on urine-treated soil. The non-urine areas were treated as control areas rather than trials in their own right. There was no reference to nitrous oxide emissions. The conclusion reached was that application of the DCD had no effect on the rate at which the pasture plants grew. Overall, it could not be said that Professor Cornforth was describing either a method or purpose consistent with the claimed Ravensdown method.

[97] The Cookson and Cornforth paper itself described the use of DCD in similar terms:

> [W]e investigated the effects of DIDIN on the concentration of NO_3^--N and NH_4^+-N in a pastoral soil to which cattle urine has been applied…fresh cattle urine…was collected on 1 March 2000 (Julian day 60) and immediately applied to the field plots. An equivalent volume of water was also applied to control plots. DIDIN was applied to plots along with urine (UR) or water…

[98] Ravensdown maintained that what the paper described was not the same use the claimed invention teaches. Professor Cameron commented that:

> [T]he work that is described by Cookson and Cornforth (2002) does not relate to treating the whole area of grazed pasture soil and appears to be designed to treat specific urine patches with other areas acting only as "controls"…They did not at any stage in their paper discuss the concept of treating the soil by covering substantially the whole of the area including animal urine and non-urine patch areas of grazed pasture soil to reduce nitrate leaching; nitrous oxide emissions; potassium, calcium or magnesiam leaching; and increased pasture production. Again the approach was on directly linking the nitrification inhibitor application to the source of the nitrogen i.e. the patches…

[99] The Ravensdown method involved, as I have already discussed, the general application of DCD without the need for contemporaneous fertiliser (urine or otherwise) and for the combined purposes of reducing nitrate/cation leaching, reducing nitrous oxide emissions and promoting pasture growth. The actions described in the Cookson and Cornforth paper do not reflect this method. The fact that there were control plots to which DCD was applied without urine does not bring that use sufficiently close to the use described in the Ravensdown specification to amount to a prior use. The use of the control plots simply highlights the fact that the purpose of the trials was to investigate the effect of DCD on urine-amended soil. I agree with the Assistant Commissioner's conclusion at [067] that the treatment of the whole pasture or non-urine-amended patches was not envisaged by the Cookson and Cornforth experiment. For this reason I do not accept that the Cookson and Cornforth paper constitutes evidence of prior use. Having reached this conclusion it is, strictly, unnecessary to consider the question of secret use. I do so, however, for the sake of completeness, because it was clearly an issue between the parties.

[100] Mr Brown submitted that there was no intention to keep the use of DCD secret and relied on the facts that the work was performed at a public institution, involved the assistance of Lincoln University staff and the paper was published online as an uncorrected proof before the priority date of 2 August 2002.

[101] The fact that the trials were undertaken on Lincoln University farmland does not give any indication either way as to whether the use was kept secret. Professor Cornforth made no reference to this aspect in his evidence and the nature of the trials were not such as to be necessarily obvious to other users of the farmland.

[102] In relation to assistance given by Lincoln University staff, Mr Brown relied on the acknowledgements at the end of the paper:

> [T]he authors also thank the Lincoln University soil quality and environmental research centre, field service centre and soil analytical services for their excellent technical assistance…

[103] However, there is nothing in this acknowledgement to indicate precisely what assistance was given. One can deduce from the paper that analysis of soil samples was undertaken. There is, however, no means of knowing whether those who provided such assistance or any other kind of assistance were permitted to know the nature of the experiment that such analysis was being used for.

[104] The third piece of evidence relied on was the release/publication of the work before the priority date. Ballance asserts that uncorrected proofs of the paper were published online in June 2002, well ahead of publication of the hard copy in October or November 2002. Proof of this publication rested partly on the evidence of a librarian, Ms Veber, who had made a search of the journal title *"Soil Biology and Biochemistry"* and downloaded a list of articles current as at 6 October 2005. The Cookson and Cornforth article was not in this list. However, the point of her evidence was to exhibit the "note to users" that appeared at the foot of the list and stated the publisher's policy regarding Articles in Press and uncorrected proofs. In essence, the notes advised that Articles in Press could be either uncorrected proofs (articles not yet finalised that will be corrected by the authors) and corrected proofs (articles containing the authors' corrections, noting that the content will usually remain unchanged).

[105] Mr Brown submitted that, on the basis of this evidence it could be concluded that if the same search had been carried out in 2002 it would have shown the uncorrected proofs of the Cookson and Cornforth paper. However, I do not accept that because the evidence provides no basis on which to conclude that a search in 2002 would have yielded the same results based on the same policy as the 2005 search did.

[106] Nevertheless, Professor Cornforth himself said in evidence that the uncorrected proofs were published online and were accessible in New Zealand in

June 2002 and there is no reason not to accept that evidence. Of course, there remains some doubt as to exactly what the uncorrected proofs contained because they were not adduced. However, on the balance of probabilities, I can conclude that the essence of the paper would have remained unchanged. Professor Cornforth also referred to the fact that the draft manuscript was sent without any request for confidentiality to a Dr Murphy of the Centre for Land Rehabilitation, University of Western Australia, for comment before it was submitted for publication.

[107] Had the Cookson and Cornforth trial constituted a prior use, I would have accepted that Professor Cornforth's evidence showed that the use was not secret. However, it did not amount to a prior use because it did not use DCD either in the way or for the purposes promoted by Ravensdown.

Prior use by Trevor Saunders

[108] I have already discussed SupaCrop in connection with prior publication and the SupaCrop brochure. Ballance adduced evidence from a farmer, Trevor Saunders, that he purchased and used SupaCrop liquid N on grazed pasture in early 2001. He said:

> My spraying unit is a 1,000L tank. I mixed approximately 4½L of SupaCrop and 18L of combo per tank (1,000L) with the rest made up with water. Each tank covered approximately 4.4 hectares. Combo contained seawead and nutrients i.e. it is not an NPK fertiliser.
>
> This meant I made up approximately 50 or so tank loads. As it would take me 20 min to fill the 1,000 tank and would take me about 30 min to spray on a 4.4 hectare area, the application took me about a week to ten days to apply the SupaCrop to all the grassed pasture on the farm at the time. The total area of grassed pasture was about 160-170 hectares. The rest of the farm was in crops at the time.

[109] SupaCrop contained urea-ammonia-nitrate and 3 percent dicyandiamide and water. Mr Saunders applied the whole 200 litre drum of SupaCrop onto approximately 160-170 hectares of grazed pasture. Mr Brown submitted that in applying SupaCrop in the way he did, Mr Saunders put SupaCrop to exactly the same use as Ravensdown claim to have invented and that on the reverse

infringement test under *General Tire* his actions would have constituted an infringement of at least some of the claims of the patent application.

[110] In response, Mr Miles submitted that Mr Saunders' purpose in applying SupaCrop was quite different to that being promoted by Ravensdown. He submitted that Mr Saunders' evidence showed that his purpose was to use SupaCrop as a fertiliser; in his affirmation Mr Saunders said that he had intended to use granulated fertiliser but was persuaded to try SupaCrop. That being the case any expectation regarding increased pasture production arose from SupaCrop's function as a fertiliser, not from the effect of DCD alone. Nor was there any indication in Mr Saunders' evidence of his intention or expectation of addressing nitrate/cation leaching or nitrous oxide production through DCD, as opposed to the fertiliser.

[111] It is evident from Mr Miles' response to Mr Saunders' evidence that a significant aspect of Ravensdown's claims is the purpose of applying DCD generally across a grazed pasture area. Mr Brown did complain several times that this was a different approach from that taken before the Assistant Commissioner, when the focus had been on the method of application rather than the purpose of application. In this regard Mr Brown specifically recorded Mr Miles' concessions that Ravensdown could not (and did not seek to) stop anyone from using DIDIN either at all or for inhibiting nitrification.

[112] Mr Brown supposed that the change from method to purpose was a response to the evidence of Mr Saunders because a farmer would infringe the patent by applying a nitrification inhibitor to substantially the whole of a grazed pasture as Mr Saunders had done by applying the product SupaCrop, which contained the nitrification inhibitor DCD. He pointed out that since the determinative characteristic of a nitrification inhibitor is its ability to inhibit nitrification and inhibition of nitrification inevitably leads to a decrease in nitrate leaching, nitrous oxide emissions and cation leaching (which leads to increased pasture growth) no new effect is achieved by the Ravensdown method.

[113] Mr Miles, however, submitted that the reason for applying the inhibitors in the claimed manner must be (and, impliedly, was) included in the inventive concept.

It is clear from the way both Mr Miles and the Assistant Commissioner characterised the claimed invention that purpose was always advanced as part of the claimed invention. Nor do I see any error in characterising the invention in this way.

Obviousness

Relevant principles

[114] Section 21(1)(e) provides as a ground of opposition:

> That the invention, so far as claimed in any claim of the complete specification, is obvious and clearly does not involve any inventive step having regard to matter published as mentioned in paragraph (b) of this subsection or having regard to what was used in New Zealand before the priority date of the applicant's claim.

[115] There are two limbs to s 21(1)(e). The first is obviousness and clear lack of inventive step, having regard to what has been published in New Zealand before the priority date of the claim under attack. The second is obviousness and clear lack of inventive step, having regard to what has been used in New Zealand before the priority date of the claim under attack. The use of the disjunctive "or" means that obviousness by reason of prior publication and obviousness by reason of prior use are to be considered separately.[21] It is also notable that the word "clearly" imposes a higher onus on the opponent seeking to demonstrate obviousness than in the corresponding revocation section, s 41(1)(f).[22]

[116] The test for obviousness was articulated in *Windsurfing International Inc. v Tabur Marine (Great Britain) Ltd*[23] and re-stated in New Zealand by the Court of Appeal in *Ancare New Zealand Ltd v Cyanamid of NZ Ltd*:[24]

> [T]he test is well established. It postulates a person (or, where appropriate, a team) skilled in the field but not inventive, invested with the common general knowledge available in the field at the priority date, presented with the prior knowledge or prior use relied on. Prior documents may be looked

[21] See Patent Office Practice Note 28 April 1993.
[22] *Beecham Group Ltd v Bristol-Myers Company (No 2)* [1980] 1 NZLR 192 at 230; *Smale v North Sails Ltd* [1991] 3 NZLR 19 at 42.
[23] [1985] RPC 59 at 73-74.
[24] [2000] 3 NZLR 299 at 309, affirmed in *Peterson Portable Sawing Systems Ltd (in liquidation) v Lucas* [2006] NZSC 20.

> at together if that is what the skilled person or team would do. It asks whether to that person or team the alleged inventive step would be obvious and would be recognised, without bringing to bear any inventiveness, as something that could be done or is at least worth trying. That is a question of fact. If any embodiment within the scope of the claim is obvious the claim is invalid.

[117] At this point I record Mr Miles' indication that, if this matter goes further, he will wish to argue that to the extent that the *Ancare* test includes something that "is at least worth trying", it should no longer be followed and that the approach of the High Court of Australia in *Aktiebolaget Hassle v Alphapharm Pty Ltd*[25] should be preferred. However, Mr Miles acknowledged that this Court was bound by *Ancare* and I proceed on that basis.

[118] In *Windsurfing* the Privy Council identified four steps which assist in applying the test for obviousness. The first is identify the inventive concept embodied in the patent. Secondly, assume the mantle of the normally skilled but unimaginative addressee in the art at the priority date and impute to him what was, at that date, common general knowledge in the art in question. Thirdly, identify what, if any, differences exist between the matter cited as being "known or used" and the claimed invention. Finally, ask whether, viewed without any knowledge of the alleged invention, those differences constitute steps which would have been obvious to the skilled man or whether they require any degree of invention.

The inventive concept

[119] In addition to his complaint (already dealt with above) that the Ravensdown claim had moved from one based on method to one based on purpose, Mr Brown argued that purpose was irrelevant to the inventive step in this case. He was relying on the Supreme Court's statement in *Peterson v Lucas* that "purpose is irrelevant. If it is an obvious step for one purpose it is not inventive to do the same thing for another".[26] However, *Peterson v Lucas* was a product claim involving the design of a sawmill and therefore quite different to the Ravensdown claim which is a method claim. This aspect of Mr Mr Brown's argument is better dealt with in relation to the last ground of appeal, that the subject matter of the claim does not define an

[25] [2002] HCA 59 at [72] – [76].
[26] [2006] NZSC 20 at [62].

invention. For the purposes of this ground of appeal I proceed on the assumption that the Ravensdown method is capable of constituting an invention for the purposes of the Patents Act 1953.

Was the claimed invention obvious having regard to prior publications?

[120] Following the *Windsurfing* test, the Assistant Commissioner was required to assume the mantle of the normally skilled but unimaginative addressee in the art at the priority date and impute to him what was, at that date, common general knowledge in the art in question (as am I, if I consider his decision wrong). In my earlier discussion regarding the Assistant Commissioner's treatment of the skilled addressee I concluded that the skilled addressee in this case would be a person with academic qualifications in the areas of soil science and biology but who also had knowledge and understanding of farming practices. The common general knowledge of such a person as at the priority date was that the application of nitrogen, whether through applied fertiliser or from grazing animals, resulted in nitrification. The chemical DCD was known to be an effective nitrification inhibitor to retard the nitrification process, one consequence of which was nitrate/cation leaching. It was not, however, appreciated that nitrous oxide emissions were also a consequence of nitrification. Nor was it known that the general application of DCD could improve pasture growth.

[121] A normally skilled but unimaginative addressee in the art at the priority date would therefore have understood the nitrification process and nitrate/cation leaching as a consequence of that process. He or she would also have understood the value of DCD as a nitrification inhibitor to retard that process. Such a person would not, however, have known from prior publications the additional consequence of nitrous oxide emissions, nor of the value of DCD in promoting pasture growth. It is evident from my consideration of the prior publications that these additional purposes were not apparent from any prior publication.

[122] Identifying the differences between the matters cited as being known as a result of prior publication and the claimed invention are self-evident from my

previous discussion. The general application of DCD for the additional purposes advanced by Ravensdown are different from the matters already known.

[123] The final step in the *Windsurfing* test was to consider whether, viewed without any knowledge of the claimed Ravensdown method, the general application of DCD for the purposes of reducing nitrous oxide emissions and promoting pasture growth would have been obvious to the skilled addressee having the common general knowledge as existed at the relevant date.

[124] The Assistant Commissioner considered that Ballance had not demonstrated that the claimed invention would have been obvious to such a person:

> [095] I am satisfied that the Opponent has not demonstrated that the invention as claimed in the independent claims (claims 1, 18, 36, 37 and 40) is obvious to a person, such as Dr Russell, who is an expert in waste treatment and dairy farm environmental management, or to a person, such as Dr Baars, who is skilled in the theoretical and practical issues involved in the treatment of soil and pastures, particularly with respect to the use of nitrification inhibitors, and is aware of the cited document discussed above. Thus, I find that this ground is not made out…

[125] I see no error in this conclusion. The evidence adduced by Ballance to the effect that the new purposes were already known or were no more than the logical extension from what was already known was unconvincing. The Ravensdown evidence was, however, convincing that the idea that a general application of DCD could not only reduce nitrous oxide emissions but also increase pasture growth was not one that any person using the knowledge drawn from prior publications would have considered either obvious or even worth a try. Therefore, the method proposed by Ravensdown for the use of DCD should not be regarded as obvious for the purposes of 21(1)(e) either by reason of what was known or used previously.

Was the claimed invention obvious having regard to the prior use?

[126] As I have already concluded at [99] the Cookson and Cornforth trial did not constitute a prior use for the purposes of s 21(1)(d) and, therefore, does not constitute a prior use for the purposes of obviousness under s 21(1)(e) either. The only prior use that can be relied on in considering obviousness is the application of

SupaCrop by Mr Saunders. Mr Brown submitted that Mr Saunders used SupaCrop to improve his pasture, although he did not know how it would achieve that outcome. Mr Brown also advanced this proposition by reference to the reverse infringement test, asserting that Mr Saunders' use would have been an infringement of the claims of the patent application regardless of whether he knew the scientific or technical effects of applying the nitrification inhibitor to his pasture.

[127] Looking at the nature of Mr Saunders' use of SupaCrop, it is clear that significant differences exist between that and the claimed invention. The use of SupaCrop was undoubtedly directed towards increasing pasture growth. However, the skilled addressee would not have regarded the inclusion of DICY in the SupaCrop product as having that effect. It was the other main ingredients that were expected and intended to have that effect. The purpose of the nitrification inhibitor was to enhance or extend the effect of those other ingredients. There is no basis on the evidence to conclude that, without any knowledge of the claimed invention, the use of DICY or any other nitrification inhibitor in itself, as a means of increasing pasture growth, would have been obvious to the skilled addressee. In order to reach the point of applying a nitrification inhibitor in the way and for the purposes advanced by Ravensdown the skilled addressee would have had to display a significant degree of invention that would overcome the very longstanding pattern of use of nitrification inhibitors at that time.

Was the Ravensdown method an invention as defined by s 2?

[128] Section 21(1)(f) permits as a further ground of opposition that the claimed invention is not an invention within the meaning of the Act. "Invention" is defined in s 2 as:

> [A]ny manner of new manufacture the subject of letters patent and granted privilege within s 6 of the Statute of Monopolies and any new method or process of testing applicable to the improvement or control of manufacture and includes an alleged invention.

[129] Mr Brown characterised the claimed invention as a mere discovery, an elucidation of how a nitrification inhibitor works and submitted that such was not the

proper subject matter for an invention. This ground of opposition failed before the Assistant Commissioner:

> [101] It seems to me that, as submitted by Mr Miles, this case is not one of "method discovery". I have already found, under the grounds of *prior publication*, *prior use* and *obviousness*, discussed above, that the invention involves a new method; the opponent has not established that the application of nitrification to substantially the whole of the pasture with the objective of reducing nitrate leaching and nitrous oxide emissions, while at the same time increasing the pasture production, was not novel or was obvious. Thus the use of the method solves long standing problems and has economic significance.

[130] Mr Brown submitted that all of the requirements of, at least, claims 1, 18, 37 and 40 in respect of benefits of using appropriate nitrification inhibitors were known both individually and severally; it was known that nitrification inhibitors in combination with fertiliser or effluent on arable soil or pasture resulted in the outcomes claimed by Ravensdown and it was known that urine, when treated with nitrification inhibitors, could be treated for the same outcomes. He said that the determinative characteristic of a nitrification inhibitor is its ability to inhibit nitrification and inhibition of nitrification inevitably leads to a decrease in nitrate/cation leaching and nitrous oxide emissions, thus leading to an increase in pasture production; therefore, no new effect is achieved by the Ravensdown method.

[131] Mr Brown also cautioned against reading into the claimed invention features which were not present in the specification. In particular, he referred to parts of Dr Russell's evidence which suggested that it was part of the claimed invention that DCD be applied separately from the nitrogen source and referred to specific rates of coverage. In fact, Mr Brown pointed out that none of the claims specified that the nitrification inhibitor was to be applied separately from the nitrogen source nor did any of the claims specify a rate of application.

[132] Mr Miles argued in response that the Ravensdown method was an invention because it offered a new use with a novel purpose for an existing product. He submitted that, although nitrification inhibitors such as DCD were known, the method taught by the patent application for the purposes of reducing nitrate/cation leaching, nitrous oxide emissions and increased pasture production was unknown.

Indeed, he said, the invention was counter-intuitive, contrary to the common general knowledge and to the direction of research at the time.

[133] Mr Miles relied heavily on the decision of the High Court of Australia in *National Research Development Corporation v Commissioner of Patents*.[27] The claimed invention in *NRDC* was a method for eradicating weeds from crop areas containing certain types of crops by applying a known herbicide. The Court held that if a new use is discovered for a known compound that serves a novel purpose then that use is patentable. The patent examiner had directed that three of the claims be deleted from the specification because the method claimed in them was not a "manner of new manufacture" in that its claims were to the mere use of known substances which did not result in any vendible product. The High Court of Australia considered, however, that:[28]

> If the new use that is proposed consists in taking advantage of a hitherto unknown or unsuspected property of the material…there may be invention in the suggestion that the substance may be used to serve the new purpose; and then, provided that a practical method of so using it is disclosed and that the process comes within the concept of patent law ultimately traceable to the use in the S*tatute of Monopolies* of the words "manner of manufacture" all the elements of a patentable invention are present...It is not necessary that in addition the proposed method should itself be novel or involve any inventive step.
>
> There may indeed be a discovery without invention – either because the discovery is of some piece of abstract information without any suggestion of a practical application of it to a useful end, or because its application lies outside the realm of "manufacture". But where a person finds out that a useful result may be produced by doing something which has not been done by that procedure before, his claim for a patent is not validly answered by telling him that although there was ingenuity in his discovery that the materials used in the process would produce the useful result no ingenuity was involved in showing how the discovery, once it had been made, might be applied. The fallacy lies in dividing up the process that he puts forward as his invention. It is the whole process that must be considered; and he need not show more than one inventive step in the advance which he has made beyond the prior limits of the relevant art.

[134] A similar approach was taken in *Mobil Oil Corp v Chevron Research Co* where the Enlarged Board of Appeal of the European Patent Office held that a patent

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[27] [1959] HCA 67 followed in *Swift & Co v Commissioner of Patents* [1960] 755 at 790 and *Swifts Application* [1962] RPC 37 at 47; approved in *Wellcome Foundation Ltd v Commissioner of Patents* [1983] NZLR 385 at 387.

[28] At pp 262-264.

could be granted for the new use of an oil additive to reduce friction, the additive previously having been used for inhibiting rust.[29] Acknowledging that if a claimed invention relates only to a discovery, it would not support a patent, the EBA held that, nevertheless, a patent could be granted if the proper interpretation of the claim was the achieving of a new technical effect which underlay the new use:

> [I]n relation to a claim to a new use of a known compound (the new purpose of such use being the only potentially novel feature), if on its proper construction the claim contains no technical feature which reflects such new use, and the wording of the claim which refers to such use is merely mental in nature and does not define a technical feature, then the claim contains no novel technical feature and is invalid.
>
> Depending on the particular wording of a particular claim, the above construction is not the only possible construction of a claim concerning the new use of a known compound, however. In particular cases it may clearly be necessary to consider and decide whether a claimed invention is a discovery within the meaning of Article 52(2)(a) EPC. An essential first step in such consideration is to construe the claim so as to determine its technical features. If, after such determination, it is clear that the claimed invention relates to a discovery or other excluded subject matter "as such" (Article 52(3) EPC), then the exclusion of Article 52(2) EPC applies…
>
> *In relation to a claim whose wording clearly defines a new use of a known compound, depending on its particular wording in the context of the remainder of the patent, the proper interpretation of the claim will normally be such that the attaining of a new technical effect which underlies the new use is a technical feature of the claimed invention*…Thus with such a claim, where a particular technical feature which underlies such use is described in the patent…the proper interpretation of the claim will require that a functional feature should be applied into the claim, as a technical feature; for example, that the compound actually achieves the particular effect.
>
> (emphasis added)

[135] In deciding *Mobil* the Enlarged Board of Appeal drew upon its decision in *Re Eisai Co Ltd* which established the "Swiss-form" claim in the pharmaceutical context:[30]

> It seems justifiable by analogy to derive the novelty for the process which forms the subject matter of the type of use claim now being considered from the new therapeutic use of the medicament and this irrespective of the fact whether any pharmaceutical use of the medicament was already known or not.
>
> The enlarged board considers that it is legitimate in principle to allow claims directed to the use of a substance or composition for the manufacture of a

[29] [1990] EPOR 73 at 86.
[30] (G05/83) [1983] EPOR B241.

> medicament for a specified new and inventive therapeutic application, even in a case in which the process of manufacture of such does not differ from known processes using the same active ingredient.

[136] Mr Brown argued that I should not adopt the approach taken in *Mobil* and submitted that the principle of technical effect articulated in the decision had not been approved by any subsequent court. It is certainly true that this aspect of *Mobil* was the subject of strong criticism in *Bristol-Myers Squibb Co v Baker Norton Pharmaceuticals Inc* in which Jacob J pointed out the difficulties that would arise under both *Eisai* and *Mobil* in determining infringement where the patent was based on purpose.[31] However, that criticism has not led to any formal disapproval of *Mobil*. The House of Lords acknowledged the difficulties identified by Jacobs J in *Merrell Dow Pharmaceuticals Inc v H N Norton & Co Ltd* but was not required by the issues before it to consider the matter further.[32] In *John Wyeth & Bros Application* the Patents Court also expressed reservations about the Swiss-form claim approved in *Eisai* but nevertheless considered that it should follow it given the status of the Enlarged Board of Appeal under the UK Patents Act 1977.[33] That course was followed by Jacob J in *Bristol-Myers Squibb v Baker Norton Pharmaceuticals Inc*.[34]

[137] In New Zealand, in *Pharmaceutical Management Agency Ltd v Commissioner of Patents*, the Court of Appeal determined that the Swiss-form of claim was valid under the Patents Act 1953.[35] The Court clearly did not accept the difficulties said to arise from the *Eisai* and *Mobil* approach; having referred to Jacobs J's criticism of *Eisai* and *Mobil*, Gault J commented that:

> [49] [J]acob J nevertheless determined he should not "go into the correctness" of these decisions and accepted, as had the Court in *Wyeth*, that novelty may rest on disclosure for the first time of a newly discovered technical effect even though a method of treatment could not be claimed.
>
> [50] Those views demand careful consideration though the House of Lords appears to have acquiesced in the *Mobil* decision, see *Merrell Dow Pharmaceutical Inc v H N Norton & Co Ltd* [1996] RPC 76 at p91. We are not called on to consider those cases nor whether they are distinguishable from that before us.

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[31] [1999] RPC 253.
[32] [1995] UKHL 14.
[33] [1985] RPC 545 at 565.
[34] [1999] RPC 253 at 272, affirmed on appeal [2001] RPC 1.
[35] [2000] 2 NZLR 529 at 536.

> [51] We have not been persuaded that there is anything in the New Zealand Patents Act or in the judicial decisions of this country which directly precludes a similar process of reasoning to that adopted in *Eisai*. We reject the contention that that decision was dictated by provisions of the EPC which are to be distinguished from the position in New Zealand.
>
> [54] In fact it is difficult to discern any reason why, even under the 1949 Act, the English Courts, if so persuaded, could not have moved to recognise novelty where it truly lies, in the new discovered use…

[138] Gault J then went on to comment specifically on the type of method claim considered in *NRDC*:

> [57] In the *NRDC* case the inventiveness lay in the discovery of the previously unrecognised property (the selective toxicity) of the known herbicide. The novelty was in the new use. Because it was non-medical, method claims were allowed, but it is not difficult to see the analogy to the aspirin example. Is the user simply using the known herbicide for its known purpose or for the new selective kill purpose?
>
> [59] As already mentioned, the Swiss-type claim is a use claim not a product claim. It is directed to use in manufacture for a purpose eg use of a known pharmaceutically active chemical compound plus a suitable carrier in the manufacture of a new cancer treatment medicine.
>
> [60] It is not a product claim …It is akin to a method claim – a method by which the newly discovered properties of the active compound can be exploited – and an essential element in the use is the intended end result – as it was in the application of the selected herbicide in *NRDC*. That all within the claim is known save for one element is not invalidating. Nor is the fact that the inventiveness is in the idea with its reduction to practice simple: *Hickton's Patent Syndicate v Patents & Machine Improvements Co Ltd* (1909) 26 RPC 339 at p347. There is novelty because it cannot be said in view of the purpose element that carrying out the prior disclosure inevitably involves doing something within the claim.
>
> [64] Just as there can be invention and novelty in the discovery of unrecognised properties in known substances qualifying for patent protectin under the doctrine of selection patents and under the decision in NRDC, so there can be invention and novelty in the discovery of unrecognised properties of known pharmaceutical compounds.

[139] Finally, in *Actavis UK Ltd v Merck & Co Inc* the England and Wales Court of Appeal conveyed clearly the validity in the UK of both the Swiss-form claims in the pharmaceutical context and general use claims based on the novel use of an existing substance. Having referred to *Eisai* Jacob LJ, giving the judgment of the Court, observed that:

> 9. So the manufacture of an old substance for use in a new treatment was considered by the Enlarged Board to be novel. The justification for

novelty was the new therapeutic use. And since the claim was to the manufacture of the compound, it was not a claim to a method of treatment.

10. In *BMS* Jacob J wondered how such a claim might work so far as infringement is concerned and thought it might create difficulty. And so it might in some cases (e.g. where the product is just sold as a standard product, like aspirin tablets). But in many cases the difficulty may be more theoretical than real. This is because manufacturers, particularly for prescription medicines and probably many others, have to provide detailed instructions and information about the use(s) and dosage(s) of their products. So in practice you can tell whether someone has used X for the manufacture of a medicament for the treatment of Y. He will have to say that his product is for the treatment of Y on his product information leaflet.

[140] Later, considering Swiss-form claims in more detail Jacob LJ said:

14. One possible view of novelty in patent law (we speak generally rather than by reference to any particular legislation) is this: that a thing is either old or it is not. If it is old, then a claim to the thing itself cannot be made novel by qualifying it with words specifying an intended use however inventive that use may have been. This was the rule in this country prior to the new, European patent system brought in by the EPC and the implementing Patents Act 1977.

16. This rule had the virtue of certainty when it came to infringement – a man who sold an old product could not infringe. The rule had disadvantages from the patentee's point of view. A method claim was not as effective in practice as a "product for" claim.

17. The rule had a more significant disadvantage in the field of medicines. For you could not get a method claim – methods of treatment were then, as they are now, precluded from patent protection. This meant that there was no patent incentive to investigate whether old substances had a medical use – not even a first medical use for an old substance would be worth researching, *a fortiori* a second medical use.

18. Things are different under EPO case law as was first established in *Eisai* in 1984. Before we examine *Eisai* in more detail it is important to note a parallel, closely related, development which occurred a little later but outside the context of medical use. In *MOBIL/friction reducing additive* G2/88 [1990] EPOR the "use of X as a friction reducing additive in a lubricant composition" was held by an Enlarged Board new notwithstanding the fact that the use of X in such a composition for the purpose of rust inhibition was known. Novelty of purpose for use can confer novelty even if the substance is old and unpatentable as such. Lord Hoffman in *Merrell Dow v Norton* [1996] RPC 76 noted the difficulties which this sort of claim may cause in respect of infringement but clearly deliberately refrained from holding that a *Mobil*-type use claim is invalid.

[141] Ravensdown's claim advances the use of an existing compound in a new way and for new purposes. Its claim is of the type considered to be valid in both *NRDC* and *Mobil*. There has never been criticism of the *NRDC* decision. In view of the

comments in *Pharmaceutical Management Agency* and *Actavis* I am satisfied that the *Mobil* approach is both consistent with *NRDC* and valid in New Zealand. Ballance has therefore not shown that the claimed invention is not an invention for the purposes of s 2.

Conclusion

[142] I have found that:

a) There was no error in the Assistant Commissioner's decision to allow the amendments to the complete specification;

b) The Assistant Commissioner correctly identified the characteristics of the skilled addressee and did not wrongly equate the skilled addressee in this case with particular witnesses;

c) The Assistant Commissioner did not err in finding that the claimed invention had not been anticipated through publication in the NZ Agrimanual;

d) There was no anticipation through publication in the form of the abstract of the Cookson and Cornforth paper, nor in the SupaCrop advertisement;

e) The Assistant Commissioner did not err in finding that the claimed invention had not been anticipated through the Cookson and Cornforth trial.

f) Mr Saunders' use of SupaCrop did not anticipate the claimed invention;

g) The Assistant Commissioner did not err in finding that the claimed invention was not obvious;

h) The Assistant Commissioner did not err in finding that the subject matter of the claimed invention was an invention.

[143] Ballance's appeal therefore fails. Ravensdown's cross-appeal succeeds.

[144] Parties may address the issue of costs in memoranda. Ravensdown may file a memorandum by 21 March 2011, Ballance by 4 April 2011 and Ravensdown in reply by 18 April 2011.

_____

P Courtney J

Claim by Ravensdown

1. A soil ~~management system~~ treatment method when used in pasture farming systems including an application of nitrification inhibitors in solution ~~form~~ and/or fine particle suspension form ~~and/or as a crystalline form~~ to ~~treat the~~ cover substantially the whole of the area including animal urine and non-urine patch areas of grazed pasture soil ~~so as~~ to reduce nitrate leaching; nitrous oxide emissions; potassium, calcium or magnesium leaching; and increase pasture production.

2. A soil ~~management system~~ treatment method when used in pasture farming systems as claimed in claim 1 wherein the nitrification inhibitor is applied in conjunction with either irrigation water, by a spray vehicle or in a similar way to the application of agricultural chemicals.

3. A soil ~~management system~~ treatment method when used in pasture farming systems as claimed in claim 1 or claim 2 wherein the ~~solution and/or fine particle suspension and/or crystalline form of~~ nitrification inhibitor is applied to a grazed dairy pasture in the autumn at a frequency and timing which reduces NO_3^--N leaching by about 76% for urine-N.

4. A soil ~~management system~~ treatment method when used in pasture farming systems as claimed in claim 1 or claim 2 wherein the ~~solution and/or fine particle suspension of~~ nitrification inhibitor is applied to a grazed dairy pasture in the spring at a frequency and timing which reduces leaching by about 42% for urine-N.

5. A soil ~~management system~~ treatment method when used in pasture farming systems as claimed in claim 3 wherein the ~~solution and/or fine particle suspension of~~ nitrification inhibitor is additionally applied to the grazed dairy pasture in the psring at a frequency and timing which reduces NO_3^--N leaching by about 42% for urine-N thereby giving an annual average reduction of about 59%, which is equivalent to reducing the NO_3^--N leaching loss in a grazed pasture from about 118 to about 46 kg N $ha^{-1}y^{-1}$.

6. A soil ~~management system~~ treatment method when used in pasture farming systems as claimed in any one of the preceding claims wherein the nitrification inhibitor is dicyandiamide (DCD).

7. A soil ~~management system~~ treatment method when used in pasture farming systems as claimed in any one of claims 1 to 5 wherein the nitrification inhibitor is ~~another type of nitrification inhibitor, such as~~ nitrapyrin or 3,4-dimethylpyrazole phosphate (DMPP).

8. A soil ~~management system~~ treatment method when used in pasture farming systems as claimed in any one of the preceding claims wherein the application of the nitrification inhibitor ~~in solution form and/or fine particle suspension form~~ promotes permeation of the inhibitor throughout a soil

surface layer enabling it to treat a greater soil volume ~~and solowing down its decomposition~~.

9. A soil ~~management system~~ treatment method when used in pasture farming systems as claimed in any one of the preceding claims wherein multiple applications of nitrification inhibitor are used to maintain the inhibition effect in the soil for a longer time period.

~~10. A soil management system when used in pasture farming systems as claimed in any one of the preceding claims wherein the nitrification inhibitor is applied as a crystalline form, either on its own or in combination with other products which allows for rainfall or irrigation to dissolve it into soil~~.

10. A soil treatment method as claimed in any one of the preceding claims wherein the nitrification inhibitor is applied in conjunction with either irrigation water, by a spray vehicle or in a similar way to the application of agricultural chemicals.

11. A soil treatment method as claimed in claim 10 wherein the nitrification inhibitor is supplied to an irrigator by a computer controlled system at a concentration dependent on the level of control required over the processes in the soil.

12. A soil treatment method as claimed in claim 11 wherein the nitrification inhibitor is injected from a supply tank into irrigation water using a flow rate controlled pump connected to an irrigation delivery pipe or irrigation hose.

~~11~~.13. A soil ~~management system~~ treatment method when used in pasture farming systems as claimed in claim 1 and substantially as hereinbefore described with reference to any one of the examples.

~~12~~.14. A delivery mechanism for use with a soil ~~management system~~ treatment method as claimed in claim 1 ~~for applying a nitrification inhibitor in solution form and/or fine particle suspension form to the whole area of the soil in a grazed pastrue system~~.

~~13. A delivery mechanism as claimed in claim 12~~ wherein the nitrification inhibitor is applied in conjunction with either irrigation water, by a spray vehicle or in a similar way to the application of agricultural chemicals.

~~14~~.15. A delivery mechanism as claimed in claim ~~12~~ 14 wherein the nitrification inhibitor is supplied to an irrigator by a computer controlled system at a concentration dependent on the level of control required over the processes in the soil.

~~15~~.16. A delivery mechanism as claimed in claim ~~14~~ 15 wherein the nitrification inihibitor is injected from a supply tank into irrigation water using a flow rate controlled pump connected to an irrigation deliery pipe or irrigation hose.

~~16.~~17. A delivery mechanism as claimed in claim ~~12~~ 14 and substantially as hereinbefore described with reference to Examples 2 and 3 and the accompanying drawings.

~~17.~~18. A method of improving pasture production in a grazed pasture by applying a nitrification inhibitor, the method including the step of applying the nitrification inhibitor in a solution and/or fine particle suspension form to treat substantially the whole ~~area~~ of the grazed pasture ~~soil~~ area including urine and non-urine patch areas to thereby reduce: (1) ~~NO_3^--N~~ nitrate leaching; (2) nitrous oxide emissions; (3) potassium, calcium or magnesium leaching in the grazed pasture.

~~18.~~19. A method as claimed in claim ~~17~~ 18 wherein the NO_3^--N concentration in a the drainage water from the grazed dairy pasture soil is reduced from about 19.7 to about 7.7 mg N L^{-1}.

~~19.~~20. A method as claimed in claim ~~17~~ 18 or claim ~~18~~ 19 wherein ~~a solution of~~ the nitrification inhibitor DCD ~~(DCD) increases~~ is used and pasture production from the whole of the grazed pasture increases by more than 15%.

21. A method as claimed in any one of claims 18, 19 or 20 wherein the nitrification inhibitor is a fine particle suspension of DCD, wherein the DCD is present at least partially in crystalline form.

~~20.~~22. A method as claimed in any one of claims ~~18~~ 19 to ~~19~~ 20 wherein the application of DCD reduced annual NO_3^--N leaching loss from about 488 to about 112 kg N $ha^{-1}y^{-1}$.

~~21.~~23. A method as claimed in any one of claims ~~16~~ 18 to ~~20~~ 21 wherein after a urine application in the spring the application of DCD reduced total annual NO_3^--N leaching loss from about 397 to about 230 kg N $ha^{-1}y^{-1}$.

~~22.~~24. A method as claimed in claim ~~19~~ 20 wherein after a urine application in the spring the application of DCD reduced total annual NO_3^--N leaching loss from about 397 to about 230 kg N $ha^{-1}y^{-1}$ and that the application of DCD reduced NO_3^--N leaching by an average of 76.1% for the urine-N applied in the autumn, and by 42.1% for the Urine-N applied in the spring.

~~23.~~25. A method as claimed in any one of claims ~~17~~ 18 to ~~19~~ 20 ~~with~~ wherein the nitrification inhibitor is DCD and further including the addition of urea applied at 200 kg N $ha^{-1}y^{-1}$ throughout the pasture and wherein, when the pasture is grazed by about 3 cows per ha, the average annual NO_3^--N leaching loss is reduced from about 118 to about 46 kg N $ha^{-1}y^{-1}$ ~~when DCD is applied to the whole area of the grazed pasture soil~~.

~~24.~~26. A method as claimed in any one of claims ~~17~~ 18 to ~~23~~ 25 wherein the increases in pasture N off-take as a result of DCD application is equivalent to

about 23% for the autumn urine treatments, and about 9% for the spring urine treatments, giving an annual average of about 16%.

~~25~~.27. A method as claimed in any one of claims ~~17~~ 18 to ~~24~~ 26 wherein DCD is applied and pasture yields increased from about 11.1 to about 13.9 t $ha^{-1}y^{-1}$ ~~when DCD is applied to the whole area of the grazed pasture soil~~.

~~26~~.28. A method is claimed in any one of claims ~~17~~ 18 to ~~25~~ 27 wherein DCD is applied 5 times in a spring urine treatment compared to 9 applications in an autumn urine treatment.

~~27~~.29. A method as claimed in any one of claims ~~17~~ 18 to ~~27~~ 29 wherein DCD is applied in two applications per year (e.g. spring and autumn).

~~28~~.30. A method as claimed in any one of claims ~~17~~ 18 to ~~27~~ 29 wherein the use of DCD reduced NO_3^--N leaching by about 76% for the urine-N applied in the autumn, and by about 42% for urine-N applied in the spring, giving an annual average reduction of about 59% to thereby reduce the NO_3^--N leaching loss in the whole area of a grazed paddock from about 118 to aboukt 46 kg N $ha^{-1}y^{-1}$.

~~29~~.31. A method as claimed in any one of claims ~~17~~ 18 to ~~28~~ 30 wherein the application of DCD resulted in a reduction in the NO_3^--N concentration in the drainage water from about 19.7 to about 7.7 mg N L^{-1}.

~~30~~.32. A method as claimed in claim ~~29~~ 31 wherein the use of DCD increased pasture production by more than 15%, from about 11.1 to aabout 13.0 t ha $ha^{-1}y^{-1}$.

~~31~~.33. A method as claimed in any one of claims ~~17~~ 18 to ~~30~~ 32 wherein the application of the nitrification inhibitor reduced calcium (Ca^{2+}) leaching by about 50% (from about 213 to about 107 kg/ha/y), reduced potassium K^+) leaching by about 65% (from about 48 to about 17 kg/ha/y), reduced magnesium (Mg^{2+}) leaching by about 52% (from about 17 to about 8 kg/ha/y).

~~32~~.34 A method as claimed in any one of claims ~~17~~ 18 to ~~30~~ 32 wherein the application of the nitrification inhibitor reduced nitrous oxide emissions following urine application in autumn from about 26.7 kg N_2O-N ha^{-1} without DCD to about 7.0 kg N_2O-N with DCD applied.

~~33~~.35. A method as claimed in any one of claims ~~17~~ 18 to ~~30~~ 32 wherein the application of the nitrification inhibitor reduced nitrous oxide emissions following urine application in spring from about 18.0 kg N_2O-N ha^{-1} without DCD to about 4.5 kg N_2O-N ha^{-1} with DCD applied.

~~34~~.36. A method of improving pasture production in a grazed pasture by applying an nitrification inhibitor substantially as hereinbefore described with reference to the examples.

37. A soil treatment method for use in a pasture farming system, the method including the application of a nitrification inhibitor in crystalline form over substantially the whole area, including animal urine and non-urine patch areas, of grazed pasture, to thus reduce nitrate leaching; nitrous oxide emissions; potassium, calcium or magnesium leaching; and increase pasture production.

38. A soil treatment method according to claim 37 in which the nitrification inhibitor is applied to a grazed pasture in the autumn at a frequency and timing that reduces nitrate leaching by about 76% for urine nitrogen.

39. A method according to claim 37 in which the nitrification inhibitor is applied to the grazed pasture in the spring at a frequency and timing that reduces nitrate leaching by about 42% for urine nitrogen.

40. A method of reducing nitrate leaching; nitrous oxide emissions; potassium, calcium or magnesium leaching; from a grazed pasture soil including animal urine patches to increase pasture production, the method including the step of applying a nitrification inhibitor in solution and/or fine particle suspension form and/or crystalline form over substantially the whole surface area of the grazed pasture.

41. A method according to any one of claims 1 to 40 wherein the grazed pasture is contained within at least one paddock.

42. The method according to claim 41 wherein the paddock is at least substantially 0.5 of a hectare in area.

43. A method according to any one of claims 37-42 wherein the nitrification inhibitor is applied in autumn and/or spring.

44. A method according to any one of claims 37-42 in which the nitrification inhibitor is dicyandiamide (DCD).

45. A method according to any one of claims 37-42 in which the nitrification inhibitor is 3,4 dimethylpyrazole phosphate (DMPP).

46. A method according to claim 6 or claim 44 wherein the nitrification inhibitor is a fine particle suspension of DCD, wherein the DCD is present at least partially in crystalline form.