

Neutral Citation Number: [2010] EWHC 1702 (Pat)

Case No: HC09C01435

IN THE HIGH COURT OF JUSTICE
CHANCERY DIVISION
PATENTS COURT

Royal Courts of Justice
Strand, London, WC2A 2LL

Date: 12/07/2010

Before :

THE HON MR JUSTICE FLOYD

Between :

FOSROC INTERNATIONAL LIMITED

Claimant

- and -

W.R. GRACE & CO.-CONN.

Defendant

Andrew Waugh QC and Joe Delaney (instructed by **Taylor Wessing LLP**) for the **Claimant**
Iain Purvis QC and Kathryn Pickard (instructed by **Mayer Brown LLP**) for the **Defendant**

Hearing dates: 24th-28th May 2010

Approved Judgment

I direct that pursuant to CPR PD 39A para 6.1 no official shorthand note shall be taken of this Judgment and that copies of this version as handed down may be treated as authentic.

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THE HON MR JUSTICE FLOYD

Mr Justice Floyd :

1. By this action Fosroc International Limited (“Fosroc”) seek revocation of European Patent (UK) No 0 415 799 (“the Patent”), which belongs to W.R Grace & Co. - Conn (“Grace”). Grace seek to meet the action by an unconditional application to amend the Patent. The amendment is opposed on the ground that it adds matter. Fosroc contend that the Patent lacks inventive step even with the amendment and, as a subsidiary point, that it is insufficient. They also seek a declaration of non-infringement: but non-infringement is now agreed to turn on the issue of validity, so I do not need to say any more about it. Mr Andrew Waugh QC and Mr Joe Delaney argued the case for Fosroc. Mr Iain Purvis QC and Ms Kathryn Pickard argued the case for Grace.

Technical background

2. The technical field of the Patent is cement of the kind used, when added to aggregates, to form concrete. There is of course nothing new in this. The roof of the Pantheon in Rome was constructed with cement made from a mixture of lime and volcanic ash. Portland cement can be traced back to the early part of the 19th century, so-called because its grey appearance made it look similar to Portland stone. Blended cements are cements in which Portland cement is blended with fillers for applications where the strength of Portland cement is not required. They have been around for a long time as well.
3. The binding effect of cement is achieved through the reaction of its various chemical phases with water. The details of this do not matter for the purposes of this action. One detail of relevance is that many of the reactions are exothermic, so that the hardening processes can be followed by measuring the generated heat. Once cement is set, its strength continues to develop over an extended period. The industry takes 28-day strength as a measure of the late-developed strength of concrete, although it may continue to develop more strength after that time.
4. Once the raw material components to make cement have been sourced, they are crushed and ground and then blended. The blended “raw meal” is then sintered in a kiln to form clinker. The clinker is then milled to form a cement powder, which is the end product of the cement plant. The cement manufacturer may have added grinding aids to assist in the grinding processes, but in general is seeking to meet a consistent specification for the cement output from the plant. In general a finer grind means a stronger cement. Grinding aids reduce the amount of energy required to achieve a given particle size or strength.
5. Cement powder is then supplied by the cement plant to ready-mix suppliers, specialist companies producing cement formulated with various additives (called admixtures) and end users. The end user may be a construction site, or it may be a manufacturer of pre-cast concrete structures.

The Patent

6. The Patent has a priority date of 6th October 1989 and was filed on 5th October 1990. It will therefore expire in a few months’ time, in October 2010. In its unamended

form the Patent is concerned with improving cement (broadly defined) by the addition of a higher trialkanolamine compound. It begins by explaining that these compounds, when added and used with a Portland cement containing composition, provide enhanced 28 day strength to the resultant set or cured composition. The Patent explains that 28-day strength has particular significance since it is the strength at this age which is most commonly used to assess the engineering properties of the final cement products.

7. At page 3 lines 11-15 the Patent describes some known additives:

“Various other additives may be added to cement to alter the physical properties of the final cement. For example, alkanolamines such as monoethanolamine, diethanolamine, triethanolamine and the like are known to shorten the set time (set accelerators) as well as enhance the one-day compressive strength (early strength) of cements. However, these additives usually have little beneficial effect on the 28-day set strength of the finished cement and in some cases may actually diminish it.”

8. The third of the compounds, triethanolamine, is referred to in the Patent and has been referred to in this action as TEA.
9. The Patent goes on to explain that the patentee has discovered that higher trialkanolamines impart 7 and 28-day compressive strength. It then points particularly (at page 3 lines 28-32) to one example - triisopropanolamine or TIPA, in the following terms:

“This discovery includes the use of triisopropanolamine (TIPA), which was previously believed to possess the equivalent cement additive properties as triethanolamine (TEA) (i.e., shortening set times and enhancing one-day compressive strengths,) but, instead, surprisingly exhibits unique 7 and 28-day compressive strength enhancing properties when added to certain hydraulic blended cements.”

10. The Patent explains that suitable hydraulic cements for use in the invention were those made from cement clinkers containing at least 4% by weight of tetracalcium aluminoferrite (C_4AF)¹ and asserts that:

“The enhanced 7 and 28-day strength exhibited by these cements were unexpected and unobvious since C_4AF was believed to have no cementing value in blended or other cements. These enhanced blended cement compositions are useful as a portland cement replacement. ”

11. All Portland cement in fact contains at least this much C_4AF . Before amendment the Patent’s widely stated objects included:

¹ Cement chemists use a lazy form of chemical notation: most chemists would write this as Ca_4AlFe . C is not carbon under this system.

- i) A blended cement together with the trialkanolamine additive having equivalent properties to Portland cement;
 - ii) A hydraulic cement mix which contains the additive in combination with certain Portland cements;
 - iii) A cement additive which is effective as a grinding aid, improves the ability of the ground cement powder to flow easily, reduces the tendency to form lumps during storage and enhances 7 and 28-day strength.
12. The specification, at page 4 lines 26-27, identifies three preferred higher trialkanolamines: TIPA and two others. At page 7 lines 5-18 it explains that the improved cement achieved by adding the higher trialkanolamine has improved 7 and 28-day strength, but does not exhibit improved early strength. It therefore suggests that conventional early strength enhancers such as the lower alkanolamines or alkali metal salts be added. The passage concludes:

“However, it has been found that a combination of these early strength enhancers with the higher trialkanolamine agents provided a cement composition which exhibits enhanced strength both in early (1 day) and latter (7 and 28 days) stages of cure.”

13. Examples 2 and 3 in the specification show that TIPA is generally superior to TEA in its ability to improve the 28 day strength of cements. Example 5 takes the matter further as explained here:

“a potential shortcoming of TIPA is its inability to improve the 1-day strength of cements. Since TEA is known to be a good 1-day strength enhancer but not a 28-day strength enhancer, one would expect that replacing a portion of the TIPA with the TEA would improve performance of the additive at 1 day, with a corresponding decrease in 28-day strength.”

14. The Example goes on to test whether this is so. The experiment involves adding pure TIPA, pure TEA and TIPA/TEA mixtures in ratios of 1:3, 1:1, and 3:1. The patentee reports the results in the following way:

“The data ... shows that replacement of TIPA with TEA improves the 1-day strength, with the 1-day strengths of TIPA/TEA mixtures falling in between those of neat TIPA and neat TEA, as expected. Unexpectedly, however, the replacement of a fraction of the TIPA with TEA also had a positive impact on the 28-day strength. Although the 7 and 28-day strengths of the cement containing neat TEA were far below those of the cements containing neat TIPA, (and in fact was considerably below the blank at 28 days), replacing some of the TIPA with TEA improved the 7-day strengths, and at 28 days the mixed additive performed significantly better than either TIPA or TEA alone.”

15. The results are set out in Table V which is reproduced below:

Table V

Results of Laboratory Test Grinds with TIPA/TEA Mixtures ²					
Additive	Dosage, % s/c	Set time, hrs ¹	Compressive Strength, kPa (psi)		
			1 Day	7 Days	28 Days
None	-	5.43	11997(1740)	36197(5250)	50401(7310)
TIPA	0.02	5.27	14341(2080)	43230(6270)	51159(7420)
TEA	0.02	4.65	15444(2240)	37783(5480)	46884(6800)
TIPA:TEA 1:3	0.02	4.83	15306(2220)	37439(5430)	55641(8070)
TIPA:TEA 1:1	0.02	4.65	14755(2140)	42196(6120)	52952(7680)
TIPA:TEA 3:1	0.02	4.82	14203(2060)	43851(6360)	55710(8080)

16. All the samples, except the control, were tested with a total dose of additive of 0.02%. The data recorded shows the effect of neat TIPA and neat TEA at this dosage, but not the effect of lower doses of the neat additives. The mixed additives, whilst employing a total dose of 0.02% employed less than this dosage of the individual additive. Nevertheless, the data record the fact that TIPA on its own increases 28-day strength by a modest amount, whereas TEA on its own decreases it. Despite this apparent negative effect of TEA, replacing part of the TIPA with TEA at a range of proportions produces a greater effect than TIPA alone.

The claims

17. Claims 1-8 of the Patent as granted were limited to “strength enhanced *blended* cement compositions” containing a trialkanolamine additive and processes for making them. Claims 9-15 were to hydraulic Portland cement compositions having enough trialkanolamine additive to enhance 7 and 28- day strength. Claim 13 claimed an additional additive: an accelerator, air entrainer, air detrainer, water reducer, or set retarder. Claim 14 claimed that the set accelerator is TEA.

The application to amend

18. The application to amend involves some fairly drastic surgery of what were originally far-reaching claims. By its application to amend Grace seek to delete claims 1-8 of the Patent as granted. They seek to limit claims 9-15 to produce a new claim 1 which claims a hydraulic Portland cement composition containing both TIPA and a set accelerator comprising TEA. This involves limiting the class of trialkanolamines to TIPA. It also involves importing TEA from claim 14, where it was claimed as an example of a set accelerator, set accelerators themselves being one of a class of additional additives claimed by original claim 13. The end result is to produce a set of claims which look like this:

“1. A hydraulic cement composition comprising a portland cement comprising at least 4% C₄AF ... by weight in combination with an additive comprising:

- (a) TIPA in an amount up to 0.2 weight percent based on the cement and sufficient to increase the 7 and 28 day compressive strength of a cement mix formed with said composition; and

(b) an effective amount of a set accelerator comprising TEA.

2. A composition according to claim 1 wherein the amount of TIPA is from 0.005 to 0.03 weight percent.

3. A composition according to claim 2 wherein the portland cement comprises at least 7 weight percent C₄AF.”

19. Grace do not contend that the unamended claims are valid. So the amendments are critical. They are objected to on the grounds that they add matter, contrary to section 76 of the Patents Act 1977 reflecting Article 123(2) of the European Patent Convention. Article 123(2) provides that:

“A European patent application or a European patent may not be amended in such a way that it contains subject-matter which extends beyond the content of the application as filed.”

20. The test for added matter is that laid down by Aldous J in *Bonzel v Intervention* [1991] RPC 553 at 574. The task for the court is to ascertain what is disclosed in the patent as filed and in the amended patent. It must compare the two disclosures and decide whether any subject matter relevant to the invention has been added.

21. It is also possible to add matter by means of intermediate generalisation, as explained by Jacob LJ in *Vector v Glatt* [2007] EWCA Civ 805 at [9]:

“A particular, and sometimes subtle, form of extended subject matter (what our Act calls “additional matter”) is what goes by the jargon term “intermediate generalisation”. Pumfrey J described this in *Palmaz's European Patents* [1999] RPC 47 , 71 as follows:

“If the specification discloses distinct sub-classes of the overall inventive concept, then it should be possible to amend down to one or other of those sub-classes, whether or not they are presented as inventively distinct in the specification before amendment. The difficulty comes when it is sought to take features which are only disclosed in a particular context and which are not disclosed as having any inventive significance and introduce them into the claim deprived of that context. This is a process sometimes called “intermediate generalisation.””

22. As pointed out by Kitchin J in *European Central Bank v Document Security Systems Incorporated* [2007] EWHC 600 (Pat) at [97], for the purposes of an added matter objection the claims form a part of the disclosure of the respective documents, although not everything which falls within the scope of the claims is disclosed. In the same judgment, at [102] he warns against the use of hindsight in the process of determining the disclosure.

23. The specification of the application for the Patent as originally filed contained claims substantially in the same form as those granted. The skilled reader would observe that

one of the specifically claimed hydraulic Portland cement compositions would be one where the trialkanolamine was TIPA and the set accelerator was TEA. This is manifest from the claim structure: the components of the combined additive are expressly mentioned in, and not simply encompassed by, the claims. To see this combination does not require the use of hindsight, or the making of a combination that was not there before. Moreover, given the presence of Example 5 in the specification, the reader would expect that precise combination to be present in the claims.

24. The specification in the Patent as granted contains the disclosure of the combination of TIPA and TEA in a single claim. But, in my judgment, there is no added matter. No new feature or other matter is added to the claims.
25. Mr Waugh's real objection was an attempted "squeeze argument" with inventive step. He said that the selection of TIPA from a list of three higher trialkanolamines (TIPA and the two others) and TEA from a list encompassing five completely different types of additives (set accelerators, air entrainers, air detrainers, water reducers or set retarders) is objectionable if Grace contend that the combination produces some sort of synergistic effect. I shall have to deal with the question of whether a synergistic effect for the combination is or is not disclosed. But it seems to me that whether or not a synergistic effect is disclosed is not relevant to this objection of added matter. The combination of the two additives was disclosed by the unamended specification. The amendment to the claims cannot conceivably have the effect of disclosing any synergistic effect for the first time. Whatever was disclosed about the synergy of that particular combination, if anything, remains the same after amendment.
26. The amendments are therefore allowable in principle. No amendments were proposed to bring the body of the specification into line with the amended claims. Mr Waugh suggested that this was because nothing would be left – but that is plainly not so. At a minimum, however, there should be some indication that only Example 5 is an example of the invention as now claimed. I will give directions as to how that aspect is to proceed, if necessary, after judgment is handed down.

The person skilled in the art

27. A patent specification is addressed by the patentee "to those likely to have a practical interest in the subject matter of his invention" per Lord Diplock in *Catnic v Hill & Smith* [1982] RPC 183 at 242-3. The Patent in this case is addressed to those in the cement and concrete industry with an interest in improving the strength of the final product. Two disputes developed in the course of this case, one as to the area of that person's activity and the other as to the nature of the person's responsibilities.
28. For Grace it was contended that the Patent was of primary interest to the cement manufacturer because the admixtures which it taught had the potential to be used both at the grinding stage and subsequently. For Fosroc it was contended that the Patent was of interest to anyone in the industry concerned with improving the strength of concrete (or maintaining its strength at reduced cost). I have no doubt that Fosroc are correct on this point. The ultimate strength of the concrete formed from cement would be of interest not only to cement manufacturers but to concrete manufacturers

as well. What is more, those concerned with manufacturing admixtures for cement, such as chemical companies looking for uses for their products, would be interested as well. Grace is one such company, but there could be others.

29. Both parties agreed that a person at the level of technical manager, for example in a cement plant, would be a member of the team to which the Patent is addressed. Fosroc also contended that the skilled team would include a research engineer concerned with implementing advances developed or identified by the technical manager or other scientists. To the extent that this is an attempt by Fosroc to bring on board a person with a greater readiness to embark on a potentially inventive research project, I reject it. Some companies in the field might have had this capacity, but many would not. Nevertheless I was satisfied that those involved in the field, whether working in cement plants, additive manufacturers or elsewhere, had the capacity and willingness to embark on simple strength testing of the effect of actual or suggested variations in the composition of cements. These tests were the subject of British, DIN and ASTM standards, and were routine. Whether they would in fact consider it worthwhile to embark on testing any particular composition is, of course, a matter to be considered under the heading of obviousness.
30. I conclude that the addressee of the Patent is a person on the technical staff at a cement plant, a concrete manufacturer or an additive manufacturer with an interest in, and the capacity to test, proposals to increase the strength of concrete.

Construction of the amended claim

31. The only dispute about construction concerned the phrase “hydraulic Portland cement composition”.
32. There was no dispute about the correct approach to construction. It is that which follows from the speech of Lord Hoffmann in *Kirin Amgen v Hoechst Marrion Roussel Ltd* [2005] RPC 169; [2004] UKHL 46. I must seek to determine what a person skilled in the art would think that the patentee was using the language of the claim to mean.
33. Grace contended that the term “cement” refers to the dry substance used to bind the aggregate materials of concrete and that in the Patent, the term “Portland cement composition” comprises the cement itself blended with the inventive additive. They submit that this is quite distinct from what the Patent describes as the cement “mix”, namely the cement composition combined with water and aggregate to produce something which will set into concrete or mortar. They submit that the amended set of claims therefore excludes the situation in which the additive is introduced into the wet concrete.
34. Fosroc contended in opening that the claim clearly covered the case where the amine was added after grinding, to the dry cement. In reply they submitted that the composition did not cease to be a hydraulic cement composition when water was added. They pointed to the fact that the specification was expressly indifferent as to the point in time when the amine is added: for example at page 4 line 49:

“It is also possible to add the subject additive, such as TIPA, as an admixture to powdered cement either prior to, in conjunction

with, or after the addition of water when effecting the hydraulic setting of the cement”

35. I was not persuaded that this dispute had much impact on the issues which I was ultimately called upon to decide. It was used primarily by Grace to argue for a more limited addressee of the specification. But, in my judgment, the skilled person would not understand the term “hydraulic Portland cement composition” to exclude the situation in which the additive is introduced into wet concrete. No reason beyond a somewhat legalistic analysis of the language was advanced. A technical person would not be able to think of a reason why the patentee would want to exclude the very situation that had been discussed.

The witnesses

36. Fosroc called Dr Charles Fentiman. He is a Chartered Engineer and a fellow of the Institute of Materials, and has worked extensively in the cement field. In his first expert report he said that at the priority date he held the post of Development Scientist and Technical Manager at Lafarge, one of the largest producers of Portland cement in the world. In fact, he was working for a subsidiary of Lafarge which was involved only in aluminous cement. Mr Purvis criticised this omission, and pointed to the fact his lack of expertise in Portland cement was demonstrated by the fact that he had limited experience of the admixture TDA and had only come across TEA as a grinding aid. He also made more general criticisms based on a suggestion that Dr Fentiman had not adopted a uniform degree of scepticism to statistically doubtful claims made in the Patent and the prior art.
37. Whilst I think that the way in which Dr Fentiman described his employment by Lafarge gave an inaccurate impression of his exposure to Portland cement manufacture as opposed to alumina cement, I am satisfied that this was not intended. Moreover Dr Fentiman demonstrated in answers to questions put to him that he had a sound knowledge of the field including Portland cement. For example he regularly dealt with mixes and blends of high alumina cement and Portland cement. I think he was a perfectly acceptable witness to assist me with the relatively modest challenges presented by the present case, even accepting that his area of specialisation was perhaps not coterminous with the technical field of the patent as now amended.
38. Grace called Mr Peter Dover who worked for Blue Circle Industries from 1968 until 2002. At the priority date he was Chief Chemical Engineer, responsible for all process engineering. His expertise was mainly in kiln and mill operation and development, a role which required him to have regard to the impact of these processes on the properties of the end product. He volunteered that he was not a specialist in concrete manufacture. This meant that he had not heard of a particular mathematical relationship between strength and water and air content called Feret’s Law, but he was plainly aware of the relationship in less mathematical terms. He accepted that it would be known to others in the field.
39. All this meant that the two experts approached the subject from slightly different perspectives. But at the level with which I am concerned, this did not matter. Both experts succeeded in explaining the subject matter to an adequate level of detail, and were trying to assist me.

Obviousness of the amended claim

40. The approach in law to the issue of obviousness is not controversial. It is summarised in the judgment of Jacob LJ in *Pozzoli v BDMO SA*, [2007] EWCA Civ 588; [2007] FSR 37 at [23]:

“In the result I would restate the *Windsurfing* questions thus:

- (1) (a) Identify the notional "person skilled in the art"
 - (b) Identify the relevant common general knowledge of that person;
- (2) Identify the inventive concept of the claim in question or if that cannot readily be done, construe it;
- (3) Identify what, if any, differences exist between the matter cited as forming part of the "state of the art" and the inventive concept of the claim or the claim as construed;
- (4) Viewed without any knowledge of the alleged invention as claimed, do those differences constitute steps which would have been obvious to the person skilled in the art or do they require any degree of invention?"

41. In *H. Lundbeck A/S v Generics (UK) Limited* [2008] EWCA Civ 311; [2008] RPC 19 at [24] Lord Hoffmann (sitting as a member of the Court of Appeal) approved without qualification a statement of principle by Kitchin J in that case which reads as follows:

"The question of obviousness must be considered on the facts of each case. The court must consider the weight to be attached to any particular factor in the light of all the relevant circumstances. These may include such matters as the motive to find a solution to the problem the patent addresses, the number and extent of the possible avenues of research, the effort involved in pursuing them and the expectation of success."

42. In *Leo v Sandoz* [2009] EWCA Civ Jacob LJ at [8] to [12] warned against too ready an acceptance of an obviousness case based upon research that the skilled person might have conducted, and which would cause him or her to “come upon” the invention, without any expectation of successfully finding a better product. He said:

“That sort of obviousness attack should be scrutinised with great care. I do not say it could not succeed, but one must be very confident that the steps said to lead to the discovery of a new and beneficial product "by accident" as it were, were at the least, really likely, almost mandated. If you need to do research to find an invention then, for a finding of obviousness, that research must be of a kind which a skilled man would do, not which he might do.”

43. Secondary indicia of non-obviousness must be kept in their place: but it is always material to ask if an invention was obvious, why was it not made before: see e.g. per Jacob LJ in *Technip France SA's Patent* [2004] RPC 46 at [122]. This should not lead to unthinking "ageism" in relation to documents cited as prior art. One should bear in mind that a new entrant to a field may wish to try something different, and should be entitled to do so provided that it is obvious: see per Laddie J in *Brugger v MedicAid* [1996] RPC 635 at 653 lines 13-40.
44. I have identified the person skilled in the art above. The matters set out in the Technical Background section of this judgment would all form part of the common general knowledge of such a person. I should deal, however, with some other aspects of the common general knowledge and then turn to the inventive concept of the amended claim.

Common general knowledge

45. *Feret's Law*: I have referred above to the fact that Mr Dover was unaware of Feret's law, the mathematical expression of the relationship between strength and cement volume, air entrainment volume and water volume. I think that this is explicable by the fact that he was principally a grinding expert. In any case he knew of the relationship in less mathematical terms. In my judgment, Feret's Law was part of common general knowledge.
46. *Admixtures*: Numerous substances were known which were added to cement to impart desired properties. The main classes are
- i) air entraining and de-entraining agents;
 - ii) water reducing agents;
 - iii) set accelerators;
 - iv) set retarders.
47. The categories overlap. For example a set accelerator may operate to enhance early strength and so on. These overlaps were also all common general knowledge. It was also common to incorporate more than one admixture, with each one imparting its known effect.
48. *Grinding aids*: TDA was a well known grinding aid marketed by Dewey & Almy which contained TEA as well as other ingredients. If TDA was used as a grinding aid in such a way as to achieve finer cement, or a finer particle size distribution, then it would have the effect of increasing strength at all ages. However, if the grinding aid is merely used to grind to the same approximate fineness, and to save energy, or is used as an admixture after grinding it would not have that effect. Dewey & Almy promoted TDA when used as a grinding aid as enhancing strength generally. There was some suggestion in an article by Kennedy that TDA's impact on strength was partly a catalytic effect, but that was not established to be common general knowledge.

The inventive concept

49. Although Grace stress the two aspects of the invention, contributed by TIPA and TEA respectively, neither side attempted a reformulation of the claim to arrive at an inventive concept. I therefore proceed on the basis of the claim as I have construed it.
50. A further issue which occupied some time at the trial is the question of whether the claimed combination of TEA and TIPA demonstrated a synergistic effect. Grace contended that, on the basis of Example 5, the combination claimed displays a synergistic effect. Mr Dover's evidence in his report was that Example 5 showed "some sort of synergy". Dr Fentiman was of the view that the data was insufficient for this purpose. His view was that one needed to see the profile of dose against 28 day strength for both of the components individually before one could ascertain whether there is a better than expected result for the combination. Although one had some idea of the dose related performance of TIPA, one did not for TEA.
51. I accept that applying standard definitions of synergy, the data presented in Example 5 fall short, on their own, of what would amount to conclusive proof. For instance, for the sample at TIPA:TEA one would strictly need, but does not have, values for 0.01% TIPA and 0.1% TEA under identical conditions
52. However, I think that in a more general sense, the patentee's conclusion that the results shown in Example 5 are unexpected is justified by the data shown there, seen in the light of the rest of the disclosure of the specification and common general knowledge. As is stated there, TEA was not known to improve 28-day strength at all, and the example shows that in the case in question the pure TEA sample was less strong than control with no additive at 28 days. One would not expect lower amounts of TEA to have produced a result in the opposite sense. Dr Fentiman said in an answer to a question I asked him that he was not suggesting that this would be the case, an answer which seems to me to accord with common sense. If that is so one would not expect a lower dose of TEA to contribute positively to the strength of the combination at 28 days. Equally, it seems to me unlikely that a lower dose of TIPA on its own would produce a better result than that achieved at 0.02% pure TIPA. Whilst in theory the dose at 0.02% might have "peaked", and lower doses produced a greater result, Table IV suggests that the dose/strength curve of TIPA reaches a plateau at 0.01%, with no evidence of a significant decline even at ten times that dose.
53. It is true that the data exhibits inherent variability, a point very much relied on by Mr Waugh. Nevertheless I conclude that the data establishes on the balance of probabilities that TEA is fulfilling a function of increasing strength at 28 days in combination with TIPA that it is unable to fulfil on its own.
54. It seems to me, however, that this finding has only a secondary relevance in the present case. Fosroc's attack on the Patent was that the skilled person would be led by routine steps that would be taken in the light of the prior art to make the claimed compositions. The claimed compositions have whatever properties they have, and are either obvious or not obvious things to make. Mr Purvis did not submit, if I concluded that the claimed compositions were obvious to make in ignorance of the unexpected benefit, that he could make use of the finding of unexpected benefit to suggest that they were nevertheless inventive. He relied on synergy simply to show

the full extent of the contribution to human knowledge made by the claimed invention.

55. In those circumstances the finding really only has significance as a secondary indication of non-obviousness. Given the valuable contribution made by TEA to the strength in combination with TIPA, the significance of the failure of the art to uncover the invention earlier may be rather greater.

The prior art

56. Fosroc rely on four citations and upon common general knowledge. The four citations are:
- i) British Patent Specification No 454,944 published in 1936: “Dewey 1”;
 - ii) British Patent Specification No 470,365 published in 1937: “Dewey 2”;
 - iii) An article by L. Müller entitled “Effect of amino acid compounds on the setting and hardening of Portland Cements” published in Zement-Kalk-Gips in February 1974: “Müller”; and
 - iv) United States Patent Specification No 4,089,696 published in 1978: “Ray”.
57. A case of obviousness is seldom enhanced by the citation of multiple prior references. This case was not an exception. I asked Mr Waugh which in his submission was the strongest from Fosroc’s point of view, and he identified the two Dewey ones. So I take these first, recognising that they are the oldest.

Dewey 1

58. Dewey 1 is entitled “Improvements in Concrete and Hydraulic cement. The object of the invention is stated to be:

“to increase the compressive strength of hardened concrete beyond that which can be obtained from any given mixture of hydraulic (e.g. ordinary Portland) cement, aggregates, and water.”

59. Dewey 1 explains its discovery as follows:

"We have discovered that the compressive strength of hardened concrete may be increased ... by introducing into the concrete a suitable quantity of a water-soluble hydroxy-alkyl amine or a salt or derivative thereof. We have found that the ethanol amines possess special advantages and of the available compounds, triethanol amine is the most effective. The commercial product consisting largely of triethanol amine together with smaller quantities of the primary and secondary compounds, is much cheaper than the pure compound and is very satisfactory. We have found, however, that in place of triethanol amine we may effectively employ other hydroxy-

alkyl amines, for example, diethanol amine or tri - isopropanol amine."

60. Triethanol amine is TEA and tri-isopropanol amine is TIPA. This passage is saying that TEA is the best of the ethanol amines, which have special advantages. Instead you can use TIPA or diethanol amine.

61. Dewey 1 teaches the use of one part amine to each 2000 to 14000 parts of hydraulic cement constituent. This corresponds to a range of 0.008 to 0.5%. It teaches that the amine may either be mixed with the water, cement and aggregates at the time the concrete is mixed, or first admixed with the dry hydraulic cement.

62. At page 2, lines 57 – 70 Dewey 1 states:

"Concrete prepared from fixed quantities of cement, water, and aggregates in accordance with the general process of this invention possesses, in the wet condition, practically the same consistency, i.e. slump and workability, as exactly similar concrete which contains none of the herein described agents, but in the hardened state, possesses a substantially higher compressive strength than the latter. The extent of the improvement in strength depends upon the cement and the mix employed as well as upon the particular amine salt selected."

63. At page 2 lines 86 to 115 it is stated:

"This invention permits the preparation, from the more usual type of portland cements, of high-early-strength cements which are equal or superior in strength to the commercial early-strength portland cements which are generally prepared by a double calcination procedure. For this purpose the portland cement clinker is ground, preferably to a superior degree of fineness, e.g. until only 10% is retained by a standard 325-mesh sieve, whereupon any of our agents is then added to the ground cement. Early-strength cements prepared according to this general procedure are not only equal to commercial early-strength materials in compressive strength characteristics but possess the additional advantage that they evolve considerably less heat during the hardening or strength-producing process than the usual early-strength materials made by the double calcination procedure. This advantage leads to hardened concretes which are more durable; for the lesser evolution of heat gives greater freedom from cracks due to cooling and consequent contraction of the finally hardened concrete, particularly where large masses are involved.

64. Finally there is this at page 2 lines 115 to 128:

The process and product of this invention may be used with advantage together with common concrete admixtures such as diatomaceous earth, which is employed to improve the

consistency of concrete, and heavy metal stearates, oleates etc., which are added to concrete to make it shed water. These materials in no way interfere with the advantageous function of the herein described agents; each ingredient performs its own advantageous function in the presence of the other”

65. There was a dispute as to whether Dewey 1 was speaking exclusively about early strength, or whether the disclosure extended to 28-day strength as well. I think the skilled reader would understand that the disclosure was a general one, and that a particular application of it is to produce high early strength concretes. Nevertheless the teaching is that the compressive strength of the hardened concrete will be improved by addition of the additive. The skilled person would understand this as an indication that there would be a positive effect at 7 and 28 days as well.

What are the differences between Dewey 1 and claim 1 and are they obvious?

66. The principal difference between Dewey 1 and the inventive concept is that Dewey 1 does not disclose the combination of TIPA and TEA.
67. Fosroc recognised that the teaching of Dewey 1 was that TEA was the preferred agent. Their case was that the reader of Dewey 1 would take up the suggestion at column 2 lines 67-70 and test other amines as well, in particular TIPA specifically mentioned at page 1 lines 61-2. They contend that the skilled person, so motivated, would discover from testing TIPA that it had the properties of poor set acceleration. They would also notice the passage at page 2 lines 115 to 128 about the use of additional admixtures for other purposes and see that the poor set acceleration of TIPA could be improved by the use of TEA in combination with TIPA. And thus they would arrive at the invention.
68. Fosroc supported their case by reference to their expert evidence. In Dr Fentiman’s first report, he expressed the view that the reader of Dewey would test the effectiveness of the various hydroxyalkyl amines and ethanolamines, particularly those expressly mentioned such as TEA, TIPA and DEA. He says that these tests would have been simple to do, were routinely done and that Lafarge employed technicians solely to conduct such experiments. He also says that the passage at page 2 line 115 would be taken to mean that the admixtures could be used in combination with set accelerators including TEA – although of course only consistency improvers and water reducers are mentioned.
69. Dr Fentiman was cross-examined, firstly, about his motivation to investigate other amines. By 1990 it would be plain to anyone in the field that the best example from the class disclosed by Dewey was TEA, and that Dewey 1 was effectively the patent for TDA. His answer as to why he would conduct the investigation was revealing:

“Q. So there is no motivation at all, is there, for doing all that research again, when Dewey & Almy have already done it, to come to the same conclusion; that it is better than TIPA?”

A. At the priority date I was in a large company that had a large central laboratory. For simple experimental work I had a team of people available to do it, I would do some of that work

myself. If there was an interest in strength enhancements, then a company such as the one I was in would have the means *to do that work without really thinking about it* and I believe that other similar companies would be in exactly the same position with sufficient technical resources that if they want to enhance the strength of their concrete, they could afford to do quite in-depth experimental work.” (emphasis added)

70. I think that, at the priority date, the skilled person would not think that there was reason to believe that there were better or even equivalent strength enhancers within the disclosure of Dewey 1. He would expect Dewey to be making the best one. The fact that a company with large resources might throw money at investigating what, by that time would have been seen as a historical disclosure, “without really thinking about it” is not a basis for concluding that the skilled team would be motivated to carry out testing.
71. Dr Fentiman was also pressed on why it was, given that we now know that TIPA was, unlike TEA, a good long term strength enhancer, that it had not emerged as such in the 50 years between Dewey and the Patent. Again, his answers did not provide a cogent explanation of why this could be:

“Q. It is inconceivable, is it not, that if that work had indeed been done and had indeed produced those results between 1936 and 1990, we would not know about it?

A. If that work had been done and, for whatever reason, not acted upon, we would not know about it. The fact that a number of years have gone past and it has been neglected, fine, but the data and the information contained is still available to the companies that *would still come up on any search for strength enhancement* and if, for many years, no one has had any interest, there may suddenly be a source of TIPA arising somewhere. So I cannot see that with a period of 50 years, I do not think it would necessarily be in the interests of Dewey & Almy to have *two products doing exactly the same thing*. For other companies, maybe TIPA was not available; maybe it is now. I do not know.

72. None of the reasons tendered by Dr Fentiman really helps Fosroc. Firstly, the fact that the document would come up on any search for strength enhancement seems to me to emphasise rather than explain the significance of the failure of TIPA to emerge for 50 years. Secondly, Dr Fentiman’s suggestion that a company such as Dewey & Almy would not wish to promote two products which did exactly the same thing would be a good explanation of the failure by them to market TIPA if it were not technically inaccurate. As is the case, and as Dr Fentiman subsequently accepted, TIPA and TEA do not do exactly the same thing: they perform quite different functions in terms of early and late strength, TIPA being significantly better at the latter and TEA at the former. On the other hand, it is correct to say that the skilled reader of Dewey 1 would in fact be likely to conclude that there was indeed no difference between them, or that TIPA was inferior. The third suggestion, that a source of TIPA might suddenly emerge, is speculation. There is no evidence that

there would have been any difficulty in obtaining TIPA if anyone had appreciated its properties. Even if it did the skilled person would have no reason to suppose that it was likely to be as good as TEA.

73. In re-examination Dr Fentiman suggested that Dewey & Almy might have held back on TIPA because of the need to go through an approval process. But I think this is unlikely given that TIPA has a real technical advantage. He was also taken back to the passage in Dewey at page 2 which speaks of the extent of the improvement depending on the molecule chosen and asked a series of undisguised leading questions about what he would do. But I do not think that any of this detracted from the genuineness of his answers in cross-examination.
74. Dr Fentiman was also unable to suggest any technical reason why the skilled person would wish, in 1989, to try TIPA or any of the other compounds suggested by Dewey 1 other than because some aspect of the performance of TEA had proved unacceptable. He was constrained to accept that if such a person tried TIPA or any of the other compounds and found it superior, he was unlikely to combine it with TEA. Mr Waugh criticised these questions as being on a false premise, but I do not think they were. Dewey 1 presents the class of compounds as doing the same job to different degrees. If for some purpose TEA was unacceptable, it is likely that the skilled person would seek an alternative and unlikely that he would then re-introduce the unsatisfactory compound.
75. Mr Dover's evidence in his first report was that the skilled person would not have had much more than historical interest in Dewey 1 at the priority date. This was based in part on the fact that by that date TEA was by then well known as an admixture for set acceleration and early strength. It was also based on his view that Dewey 1 contained no clear indication that it was concerned with developing late as opposed to early strength. He maintained the position in cross-examination that although the document was not clear, one's reading of it in 1989 would be coloured by the fact TEA was by then known to be an early and not a late strength enhancer.
76. Mr Dover's cross examination was based on a number of assumptions as to what the skilled person would do. Firstly, he was asked to assume that he had understood from Dewey 1 that TIPA was one of the hydroxyalkyl amines that could be effectively employed. Secondly he was asked to assume that TIPA had been chosen to take forward and test. In those circumstances he accepted that tests would be likely to show that TIPA had (a) relatively poor set-accelerating early strength and (b) relatively improved strength at 28 days. He also accepted that the skilled person would be able to add conventional set accelerators such as the lower alkanolamines as well as the alkali metal salts
77. I have come to the conclusion that the obviousness attack over Dewey 1 fails for essentially the following reasons:
 - i) By the priority date the skilled person would have no technical motivation to investigate other compounds from the class identified by Dewey 1. He would be entitled to assume that TEA had in fact proved to be the best compound. It is impossible therefore to conclude that this is research that the skilled person would do.

- ii) If the skilled person did embark on testing, there would be no expectation by 1989 that superior or even equivalent compounds would be found amongst those disclosed. The testing programme is of the exploratory kind, conducted with no expectation that anything useful will come of it.
- iii) The cross examination of Mr Dover was based on the assumption that TIPA was selected to take forward. But Dr Fentiman's evidence was not to that effect. The testing he envisaged included a wider range of compounds. There is no evidence of what such a broadly based project as actually envisaged by Dr Fentiman would reveal. The selection of TIPA as the compound to take forward involves an element of hindsight. There is certainly no evidence to suggest that TIPA would stand out amongst all the compounds tested.
- iv) Mr Purvis took a further point, namely that even if TIPA was selected, there was no evidence that the precise conclusions needed for the obviousness attack, for example poor early strength, would emerge clearly enough to prompt the skilled person to take the next step and add TEA. He pointed to the fact that the results in the Patent for some cements showed that TIPA was as good as TEA: see e.g. Table II(a). He submitted that we did not know what cements would be chosen for the testing project, and that I should not therefore assume that the results would lead in the direction suggested. I have placed no reliance on this point, as it seems to me that, in fairness, it should have been put to Dr Fentiman. Whilst it is true that Dr Fentiman's written evidence did not go as far as suggesting what would be discovered by the testing programme, the absence of any view from Dr Fentiman has to be set against Mr Dover's ready acceptance of what would be revealed.
- v) Finally this is a case where the failure of the art to come up with the invention is particularly telling. Whilst other explanations are of course possible, it seems to me from the evidence in this case that by far the most likely explanation is that there was simply no motive to conduct the relevant research work. Even if it were to be undertaken, it would be undertaken with no expectation of finding anything as good as TEA.

Dewey 2

- 78. Dewey 2 is what was described under the then current patent legislation as a "patent of addition" to Dewey 1. Its title is "Improvements in or relating to Hydraulic Cement". Not surprisingly, therefore it contains extensive cross-reference to Dewey 1.
- 79. Dewey 2 builds on the disclosure of Dewey 1 by explaining the benefit of adding the amine at the stage of grinding the clinker:

"As one method of incorporating the hydroxy-alkyl amine into the cement itself, an attempt was made to introduce the compound with the clinker into the mill (ball mill) used for grinding the cement clinker and the very surprising effect was observed that the incorporated hydroxy-alkyl amine was also effective in improving the grinding conditions and milling conditions generally."

80. The result is:

“Subsequently, when the ground, finished cement is used in concrete, the strength of the concrete is increased to a somewhat higher degree than when the hydroxy-alkyl amines are added to the gauge water.”

81. The teaching as to the relative merits of the various amines remains similar. TEA is described as the “most effective”, but is said that both TIPA and DEA may be effectively employed.

What are the differences between Dewey 2 and claim 1 and are they obvious?

82. The differences are the same as for Dewey 1. Mr Waugh relied on the fact that, as a grinding aid, the additive has the potential to increase strength by altering particle size and particle size distribution. Hence the skilled reader would have more reason to suppose that the admixtures improve late strength as well. But I have treated Dewey 1 on the basis that it teaches strength improvement in general, although, through 1989 eyes, its teaching would be coloured by what was known in practice about TEA.

83. The cross-examination of Mr Dover again started from the assumption that TIPA was chosen to take forward instead of TEA. For the same reasons as I have indicated in relation to Dewey 1, I do not think that this represents how the skilled person would have proceeded in 1989. There would have been no perception or expectation of worthwhile results.

Müller

84. Müller was published in 1974. Müller studied the effect of amino compounds on hardening of cements by following, in the laboratory, the variation of temperature with time. Table 2 contains a list of 25 amino compounds of which TEA is compound 15 and TIPA is compound 21.

85. The results for TEA showed that:

- i) it brought forward the onset of setting by about 2.5 hours irrespective of dosage;
- ii) it retarded the position of the temperature maximum by 33-78 hours.

86. The corresponding results for TIPA showed that:

- i) it retarded setting by about 2-2.4 hours except for the highest dosage where it brought it forward by 2.5 hours;
- ii) it retarded the rate at which final strength developed by between 0.7 and 1.6 hours except for the highest dose where it delayed it by nearly 3 hours.

87. Table 4 shows the effect of a number of additives including TIPA and TEA on the early (6 hr and 24 hr) strength of the cement. The Table shows:

- i) At a water/cement ratio of 0.5, both TIPA and TEA showed a reduction in compressive strength at all doses.
 - ii) At a water cement ratio of 0.4, when 0.025 mol/kg (i.e. 0.5% by weight) of TIPA is used, the 24 hour compressive strength of the resulting cement increases from 268 to 304 kp/cm³, i.e. a 13% increase. At the higher dose of 0.2 mol/kg, the effect is to reduce it to 33 kp/cm³.
 - iii) The result for another compound, dimethylaminoethanol, at this water/cement ratio is marginally better than TIPA at the low dose.
88. TEA, on the other hand is shown to reduce 24 hour strength at all doses at this water/cement ratio as well. The comparable figure for triethanolamine was 268 to 14 kp/cm³, a reduction by a factor of 19.
89. Müller explains that the choice of the 0.5 water/cement ratio was based on the DIN standard specification. He noted that this was in contradistinction to the results of the temperature measurements. He therefore adjusted the ratio first to 0.35, where he noted that the test pieces were too dry, and therefore chose the alternative of 0.4.
90. The author concludes
- “Dimethylaminoethanol and [TIPA] at lower addition values lead to an increase in strength after 24 hours, while [TEA] in this case too interferes with strength development.”

What are the differences between Müller and claim 1 and are they obvious?

91. The differences here are that there is no express disclosure of (a) late strength effects (b) the combination of TEA and TIPA and (c) the dosage range claimed in claim 1.
92. Dr Fentiman’s view was that, based on these results, it would be highly surprising and unusual if later strength was not also increased by TIPA, although one could not tell from 24 hour strength whether the 7 day strength would be better than control. He said that he would have got a couple of technicians to carry out tests to see whether this was true. Fosroc’s case then followed similar lines to that based on Dewey, that the skilled person would discover that TIPA did not do much for early strength but increased late strength, and that this defect could be fixed by combining it with TEA.
93. In my judgment this argument is more difficult for Fosroc than that based on Dewey, as was demonstrated by the cross-examination of Dr Fentiman. Dr Fentiman’s report had made no mention of the data at 0.5 water/cement ratio, or of the author’s reasons for changing the ratio from the DIN standard. However he accepted that these showed both TIPA and TEA to be worse than control.
94. As to Müller’s reasons for changing the water cement ratio, Dr Fentiman:
- i) appeared to me to recognise that the reason given (inconsistency with temperature measurements) was not a good one as temperature did not tell you about strength;

- ii) speculated that Müller was having problems with plasticity caused by the admixture at the higher ratio, but accepted that this was not the reason given by Müller and that there was no basis for it in the text. He said that this was a criticism of the article he himself would have made if he had been asked to review it;
- iii) accepted that, viewed in that way Table 4 gave one figure suggesting a decrease in early strength and one suggesting an increase: a contradictory result. He said:

“The data point for 0.5 (water/cement) certainly is not helpful”;

- iv) a typical concrete would have a water/cement ratio of 0.6, and he had no reason to doubt the proposition that at the higher water/cement ratio the correlation with ultimate compressive strength values of concrete is normally better;
 - v) that the DIN standard would have specified 0.5 because that was the water/cement ratio which would have given as good a correlation as possible with concrete.
95. Dr Fentiman accepted that there was something odd about the TEA results as well. TEA was known as an early strength enhancer, but is shown in this work to decrease 24 hour strength as compared to control. Dr Fentiman put this down to the high dosages used, which were not representative of the low doses used in practice. None of this would give the skilled person much confidence in the work.
96. Dr Fentiman’s evidence was that the data Müller gives about temperature maxima would have enabled him to conclude that there was indeed an increased rate of hydration for TIPA in the first 24 hours indicating faster strength development. However he recognised in cross-examination that this temperature data was only a single data point giving the location of the peak for each amine. Moreover the curves in Figure 8 were a direct measure of the rate of calcium hydroxide formation, which is a way of following hydration. These showed that both TIPA and TEA slowed hydration as compared with control. Dr Fentiman said he may have missed this aspect of the paper. This makes it all the more puzzling that Müller diverted from his original DIN standard test: as those results were in fact consistent with those in Figure 8.
97. Mr Dover recognised that the chemistry of cement setting was not his expertise. However, he was much more sceptical of the value of the Müller paper than Dr Fentiman. As a scientist and engineer, he found the justification for changing the basis of the experiment to a new water/cement ratio “somewhat disturbing”. These were non-standard tests, which had been “cobbled together”. He considered that it was “amazing” that the journal, which was a most respected one, had let this paper through. He defended his position that he would not see adequate data in Müller to take an experimental program forward. He would have sent away anyone who suggested it “with some different priorities”.

98. In my judgment, Müller does not render the invention of claim 1 obvious. At best, it sends out an ambiguous message as to the performance of TIPA as an early strength enhancer. The skilled person would regard it as a piece of work, more academic than practical, conducted under unrepresentative, unjustified and unjustifiable conditions producing conflicting and confusing results which in many respects would be contrary to his own experience. It would not, and apparently did not, lead anyone to conduct the programme of experiments suggested by Dr Fentiman, despite the length of time which passed between its publication and the priority date.

Ray

99. Ray is entitled “Hydraulic cement mixes and process for improving hydraulic cement mixes”. Ray is really about acetins, which are acetic esters of glycerin and which it claims impart improved compressive strength to concrete. However, Ray includes comparisons with TEA and TIPA.
100. Ray explains the problem in the following terms. Admixtures which are known to improve compressive strength also tend to retard set. Thus it is known to take steps to increase the rate of hydration, including the use of accelerators. Ray mentions TEA as an example of a known accelerator. The combined use of retarders and accelerators is, however, said to lead to unpredictable results. It is said (for example at column 3 line 23) to be an object of the invention to provide increased strength without adversely affecting setting times. This is achieved by the use of a quantity of the acetin admixture.
101. Ray conducts several series of tests with different acetins at a variety of doses, measuring rate of hardening and the compressive strength at 7 and 28 days. It is in this connection that he mentions the comparison with TEA, as he says this is a “known and commercially available ... accelerating admixture”.
102. Table I contains results for a number of experiments, from which Ray concludes that:
- “the addition of the acetins resulted in a generally beneficial acceleration of the setting times ... In comparison to the use of a triethanolamine admixture, which is a well known, commercially available accelerator, the acetins produced comparable compressive strength gains, while achieving a lesser degree of acceleration”.
103. Table II contains a further set of results, in which comparisons are made with what is described as a:
- “commercially available mixed isopropanolamine admixture, which is comprised predominantly of triisopropylamine and is also known as an accelerating agent.”
104. This reference to TIPA as a component of a known and commercially available admixture in a document published in 1978 is puzzling, as neither side’s expert knew to what this was referring, and the parties’ own researches have not unearthed what it was. It certainly did not form part of the common general knowledge.

105. Table II does not contain any results for the effect of the isopropanolamine admixture on its own. It contains results only for the combination of the admixture and diacetin at dosages of 0.025 and 0.05 respectively. The 28 day strength reported for this mixture for Cements Nos. 1 and 2 are 5030 and 4985 psi respectively (see examples 62 and 72). To find a result for this dose of diacetin without the isopropylamine admixture, one has to go to Table I where the results are 5505 and 5190 psi (see examples 24 and 32). Both values are higher in absolute terms than the results when the same amount of diacetin has additional help from the isopropanolamine admixture. However, as with all comparisons, it is necessary to ensure that what is being compared is on a like-for-like basis.
106. From the data in Table II it is apparent that those additives which consist of diacetin together with mixed isopropanolamines (mixes 62 and 72 in Table II) are effective in increasing both 7 and 28-day strength. This can be seen from comparing mix 53 (control) with mix 62 (diacetin plus mixed isopropanolamines), and mix 63 (control) with mix 72 (diacetin plus mixed isopropanolamines).

What are the differences between Ray and Claim 1 and are they obvious?

107. There are two differences between Ray and claim 1. The first is that there is no express disclosure that TIPA, absent diacetin, would increase 28 day strength. The second is that there is no disclosure of the combination of TIPA and TEA.
108. Mr Dover, relying on the comparisons referred to above, suggested that TIPA in fact decreased 28 day strength in absolute terms. Dr Fentiman took issue with this on the basis that both water content and air entrainment have an effect on strength. The figures for water and air content are included in the Tables: so one should conduct the comparison in a way which allows for these differences. Dr Fentiman produced these analyses, based on Feret's law, to produce values for the K constant. These results then show that the mixture of isopropanolamines increases rather than decreases 7 and 28 day strength. He contended that these are analyses that the skilled person would have done and that the observation that isopropanolamine increases strength would "accidentally drop out" of the analysis.
109. Dr Fentiman attempted to justify this approach to the document as one which would have been adopted by a skilled team at the priority date. Whilst I have no doubt that this justification was put forward in good faith, I was wholly unconvinced by it. In the course of his explanation he repeatedly used phrases such as "close scrutiny" and taking "a close look at the data", but I was unable to discern, taking account of the overall purpose of the document, why he thought that this analysis in relation to TIPA would be either necessary or useful. I can certainly understand that a researcher might wish to see to what extent the improvement in strength apparently shown by the acetins was due to water reduction or to some other phenomenon, but I am wholly unclear why this would necessarily involve an analysis of, or seeking to draw conclusions in relation to TIPA.
110. My reasons are as follows:
 - i) The thrust of the teaching of Ray is concerned with acetins. The data he gives in relation to TIPA is both inadequate for drawing conclusions about TIPA and purely incidental;

- ii) Ray would therefore set the skilled person off in a direction which has nothing to do with TIPA;
- iii) The express disclosure of Ray is that TIPA is another set accelerator, like TEA: there is no suggestion that it could act as a strength enhancer on its own;
- iv) There is no reason why, starting from Ray, a skilled person would necessarily wish to engage in the close scrutiny of the results in relation to mixtures of isopropanolamines and diacetin;
- v) The analysis of Ray is in any event over-theoretical because the effect of adding the TIPA may be to entrain air. If the skilled person fears that the decrease in strength being observed has to do with air entrainment, then that is a feature associated with adding TIPA. Dr Fentiman's answer was that if inherent strength can be improved with TIPA, then one could add an air de-entrainer with it. But I think the proper conclusion in those circumstances is rather that the skilled person would not think it useful to do the analysis at all.

111. Accordingly Ray does not, in my judgment, render claim 1 obvious.

Conclusion on obviousness

112. None of the obviousness attacks succeeds.

Subsidiary claims

113. It is not necessary to consider these, as claim 1 as amended is valid.

Insufficiency

114. A number of objections of insufficiency were pleaded. But in the end none of them were seriously pursued. An objection of lack of patentable subject matter (discovery as such) falls into the same category.

Result

115. The amendment is allowed, subject to the point made at paragraph 26 above. The amended claims are valid.