



OUTER HOUSE, COURT OF SESSION

[2017] CSOH 108

CA71/14

OPINION OF LORD DOHERTY

In the cause

DUNDEE CITY COUNCIL, ANGUS COUNCIL and PERTH AND KINROSS COUNCIL,
carrying on business together under the name and style of TAYSIDE CONTRACTS

Pursuers

against

D GEDDES (CONTRACTORS) LIMITED

Defender

**Pursuers: Howie QC, R Anderson; Gillespie Macandrew LLP
Defender: Ellis QC, Balfour; BLM**

18 August 2017

Introduction

[1] The pursuers are a combination of local authorities carrying on business under the name and style of Tayside Contracts. In the summer of 2010 the pursuers carried out surface dressing works on a number of roads for Dundee City Council, Angus Council, Perth and Kinross Council (“the constituent councils”) and for Falkirk Council. The pursuers purchased from the defender the aggregate chippings they used for those works. Many of the works failed in early course.

[2] In this commercial action the pursuers attribute those failures to the chippings which the defender supplied. They maintain that the chippings were not of satisfactory quality and that they were not fit for the purpose of use as surface dressing on roads in eastern Scotland; and that as a result the defender was in breach of the terms implied into the contracts of sale by sections 14(2) and 14(3) of the Sale of Goods Act 1979. They seek damages in respect of those breaches.

[3] The previous procedure in the present action included two debates. Following the first debate the defender's plea to the competency of the action was repelled (*Tayside Contracts v D Geddes (Contractors) Ltd* 2014 SLT 764). The outcome of the second debate was that on 18 November 2014 certain of the defender's averments were excluded from probation. Sundry procedure thereafter included amendment of the pleadings. A proof before answer restricted to the issue of liability was set down to take place on four days in June 2015, but it was discharged on the defender's motion less than two weeks before the diet was to commence. A diet of four days commencing on 1 March 2016 was assigned in its place. The diet began on 1 March 2016 before Lord Jones. On that day the evidence of the pursuers' first witness, Mr Cranney, was completed, but on the joint motion of the parties the case was then adjourned until 9 June 2016 and the five following days (senior counsel for the pursuer was ill and it had also become clear that the case would not be completed in the four days which had been allocated to it). Sadly, Lord Jones died on 12 March 2016. The continued diet of proof was set down to proceed on 16 May 2017 and the following five days. A transcript of Mr Cranney's evidence was prepared (53 of process). Parties were agreed that it was unnecessary that Mr Cranney be recalled.

[4] Shortly before the resumption of the continued proof the pursuers were allowed to further amend their pleadings and to add Professor Gordon Airey as an additional witness.

Prior to the amendment the pursuers had averred that the mechanism of failure of the surface dressing was that the chippings had been liable to “dusting up”, and that because they had dusted up before use there had not been proper adhesion between them and the bitumen binder. The amendment also posited a second cause of failure - that the mineralogical composition of the chippings made them liable to strip from the binder.

[5] At the continued diet the pursuers called eight witnesses: three of their employees (Joseph Foley, Douglas McKay and Gary Mitchell); two former employees (Brian Johnston and Ewan Duncan); two expert witnesses (John Baxter and Professor Gordon Airey); and the Area Bitumen Sales Manager for Nynas UK AB (“Nynas”) in Scotland (Nigel Hardy). In addition (in terms of paragraph 4 of the Joint Minute no. 64 of process) it was agreed that the witness statement of Iain Gardiner should be received in evidence without the necessity for his attendance at the Proof. The defender called nine witnesses: four of its employees (Craig Geddes, Robin Geddes, Scott Gormley and Phil Thacker); four expert witnesses (Karen Dalglish, Dr Rachel Hardie, Dr Murray Reid and Professor John Knapton); and the managing director of Stanger Testing Services Limited (Laurie Murphy). The evidence occupied the first five days of the diet and on the sixth day I heard submissions. I am grateful to counsel for their written and oral submissions.

The Expert Witnesses

[6] Mr Baxter is a civil engineer. He was aged 75 at the proof. He described himself as essentially retired, though continuing to act occasionally as a consultant. He had fifty years’ experience in quarrying, road surfacing and highway maintenance. He had been a member of the Road Surface Dressing Association, of the Transport Road Research Laboratory

College of Observers, and of the committee that had produced the current edition (Sixth ed., 2008) of Road Note 39 - Design guide for road surface dressing.

[7] Professor Airey is Professor of Pavement Engineering Materials, and Director of the Nottingham Transportation Engineering Centre at the Faculty of Engineering in the University of Nottingham. He described himself as having experience of the bond between stone and bitumen and the process of breakage or stripping. He indicated that he did not have expertise or experience in the field of consulting on road dressing failures, and that his opinion in the present case was “purely academic and scientific”.

[8] Ms Dalglish, Dr Rachel Hardie and Dr Murray Reid are all expert geologists and mineralogists. All have expertise and experience in the geological and mineralogical aspects of aggregates used in road construction.

[9] Professor Knapton is a pavement engineering expert. He was formerly Professor of Structural Engineering at Newcastle University. Throughout his long career he has practised as a civil engineer. He has considerable experience in pavement engineering works.

Credibility and Reliability

[10] No issues of credibility arose. With one qualification, I am satisfied that each of the witnesses was doing his or her best to assist the court. The qualification is that I have reservations as to whether Mr Cranney and Mr Hardy were entirely frank with the court as to the circumstances leading up to the supply of binder in 2011. More generally, while for the most part I have accepted that witnesses' evidence was reliable, it will be plain from what follows below that I have not accepted all of the evidence of every witness. In particular, I have not accepted parts of the evidence of Mr Baxter and Professor Airey.

Neither have I accepted all of the evidence of lay witnesses. In particular, there were occasions when Mr Cranney proffered evidence which might be interpreted either as merely setting out Mr Baxter's views, or as bearing to give skilled opinion evidence of his own. I tend to the view that it was merely the former (but had it been the latter I would have attached no weight to it since Mr Cranney was not independent of the pursuers and because, in any case, I found it unpersuasive). In addition, at the beginning of his re-examination Mr Hardy gave evidence which he would only have been qualified to give had his possession of relevant expertise been established. However, there was no attempt to set him up as a skilled witness. I have attached no weight to that evidence for that reason. Besides, I would have been inclined to attach no weight to it because in my opinion the question which elicited it suggested the desired response, and because no reasoned explanation of the answer was provided.

Background

[11] Surface dressing is a process which involves the application of stone chippings and a bitumen binder to a road or pavement. The aim is to waterproof the road and to restore skid resistance. A film of binder is sprayed on to the road. The type and quantity of binder used depends upon a number of factors, including the hardness of the surface upon which the binder is to be applied. Chippings are then spread on to the binder and rolled into it. For a successful surface dressing the chippings need to be properly embedded in the binder. Proper embedment is achieved by two mechanisms, both of which are essential: (i) by rolling the chippings into the binder using a roller; (ii) by traffic passing over the chippings during the months between their initial placement and the onset of colder weather. If a chipping is properly embedded in the binder the mechanical forces which the binder exerts

on it are more important to the chipping staying put than the adhesion between the chipping and the binder.

[12] Bitumen is a thermoplastic material which softens when heated and becomes hard and brittle when cooled. At higher temperatures it can become too soft to hold the chippings in a surface dressing system, and at cooler temperatures it can become so hard and brittle that it fractures under traffic stresses and loses chippings. Polymer modified bitumen emulsions widen the temperature range over which bitumen exhibits good binder properties.

[13] The surface dressing season in Scotland runs from May until August. Outwith that season road temperatures over the relevant period are unlikely to be conducive to a successful outcome. Best practice is to complete surface dressing by the end of July because even if late summer/early autumn temperatures during the day remain warm, often it is cold at night.

The Pursuers' Capacity to enter into the Contracts

[14] While senior counsel for the defender did not formally concede that the pursuers had capacity to contract and that they had exercised that capacity to enter into the contracts with the defender, he did not challenge the evidence which the pursuers led in support of those propositions. In the circumstances it is unnecessary to set out that evidence. It was summarised in paragraphs 3 and 4 of the pursuers' written submissions. I accept it. I am satisfied that at the material times the pursuers had capacity to contract and that the contracts with the defender were *intra vires* of the pursuers.

The Contracts between the Pursuers and the Defender

[15] In March and April 2010 the pursuers received requests to provide quotations to carry out surface dressing work for each of the constituent councils and for Falkirk Council. The surface dressing design was the client responsibility. The design included factors such as the type of bitumen binder to be used, the rate of spread of binder, the size of chippings, and some of the characteristics of the aggregate. The design from Angus Council specified a minimum polished stone value ("PSV") of 60, whereas with the other councils' designs a lower minimum PSV would have sufficed. The pursuers' usual local sources supplied chippings with a lower PSV than 60. The pursuers and the defender discussed the pursuers' requirements. Chippings from the defender's Waulkmill Quarry (at Friokheim, Angus) had a PSV of at least 60. The defender indicated that they were suitable for surface dressing. At the pursuers' request the defender provided them with samples of 10mm and 6mm chippings. In March 2010 the pursuers carried out tests on the chippings, including tests for grading, moisture content, and flakiness. At the pursuers' request their bitumen binder supplier, Nynas, tested a sample of washed chippings for adhesion to bitumen using the Total Water Immersion Test ("TWIT"). The results of all of the tests were satisfactory. In particular, the Nynas test (6/7 of process) demonstrated good adhesion qualities (95% after 48 hours at 40 degrees C (a normally acceptable result for such conditions being 65% or above)).

[16] On 7 April 2010 the pursuers and the defender concluded a contract for the sale by the defender to the pursuers of 2,100 tonnes of 10 mm washed surface dressing chippings and 1,400 tonnes of 6 mm washed surface dressing chippings from Waulkmill Quarry. Shortly thereafter the parties concluded several further contracts of sale for further quantities of 10 mm and 6 mm chippings from the quarry. In all, the total quantity

purchased was 8,764.59 tonnes. The total price was £176,631.26. Each of the contracts was governed by the defender's standard terms and conditions.

[17] It was common ground that it was an implied term of each of the contracts that the goods would be of satisfactory quality (Sale of Goods Act 1979, s. 14(2)). The defender did not contend that any of the sales had been a sale by sample.

[18] The pursuers maintain that it was also an implied term of each of the contracts that the chippings were fit for the particular purpose of use as surface dressing chippings in roads in eastern Scotland (Sale of Goods Act 1979, s. 14(3)). In Answer 9 of the defences the defender put the pursuers to their proof on that matter, but it averred that the chippings supplied were in any case reasonably fit for that purpose. In my opinion there was ample evidence that the defender was made aware of that particular purpose. I am satisfied on the evidence that it was an implied term of each of the contracts that the chippings were fit for the particular purpose of use as surface dressing chippings on roads in eastern Scotland.

[19] I find it convenient to note at this point that during closing submissions senior counsel for the defender sought to advance a defence that the pursuers did not rely, or that it would have been unreasonable for them to rely, upon the defender's skill and judgement in so far as the issue of adhesion between the binder and the chippings was concerned. He submitted that they had relied rather upon the Nynas test results (6/7 of process); or that if they had relied on the defender's skill and judgement that it had been unreasonable for them to do so in the circumstances. In my opinion the defences gave no notice of any such defence. The only reference in them (Answer 5) to the Nynas test related to a different matter. Had the defender wished to found upon such a defence it was incumbent upon it to raise the issue in the defences (or by some other clear means) in advance of the proof. It did not do so. I am not prepared to entertain the submission now.

[20] The parties are at odds as to whether at the time of contracting the defender's website stated that its chippings were "especially suited" to surface dressing. It was not suggested that it was a term of the contract that the chippings were especially suitable for use in surface dressing. The pursuers' position was that the statement on the website was a relevant circumstance to be taken into account when determining whether the aggregate was of satisfactory quality. However, while I think it clear that such a statement did appear on the website from about 2011, I am not satisfied on the evidence that it appeared there at the time of contacting.

[21] Prior to the pursuers' contracts, chippings from Waulkmill had not been used for surface dressing during the defender's operation of the quarry. On one occasion a quantity had been sold for that purpose but it had been returned by the buyer because it had not been properly washed. At that time the defender had not had adequate wash plant at the quarry. It is possible that before the defender began operating the quarry previous operators may have supplied chippings from it for surface dressing; but the evidence on that matter was at best anecdotal.

The Works

[22] During the summer of 2010 the pursuers carried out surface dressing work for the constituent councils and for Falkirk Council. Almost all of the relevant surface dressing work was done by the end of July (it seems that a relatively small quantity of work at Glenfarg was carried out in the second week of August). The chippings purchased from the defender were used for those works. They were delivered to the pursuers' depots, or in some cases directly to the sites where work was to be done. The deliveries carried on

throughout the surface dressing season in order to keep pace with the pursuers' ongoing work programme.

[23] The client councils specified that polymer modified bitumen emulsion binders be used. The pursuers used such binders, which they obtained from Nynas. In some cases the binder was Fleximuls (an intermediate polymer modified binder) and in some cases it was Duramuls (a premium polymer modified binder).

[24] The aggregate which the defender supplied to the pursuers had been duly tested and it complied with all relevant applicable regulations and industry standards for surface dressing.

The Emergence of Problems

[25] In the autumn of 2010 there were some reports of loose chippings on roads which had been surface dressed, but I am satisfied that at that stage the number and nature of the reports were not markedly different from what might usually have been expected following works of this type. Significant failures did not emerge until after the onset of very cold weather. The winter of 2010/11 was exceptionally cold and severe. There were very cold spells in late November and December. Recorded temperatures dropped as low as -19 degrees C at Strathallan, -16.7 degrees C at Kinross, and -11.1 degrees C at Grangemouth.

[26] During January 2011 it became evident that the nature and scale of loose chippings reported was very significant indeed. That trend continued during the following months. By the early Spring of 2011 it was apparent that the problem was widespread and that most of the surface dressing sites had experienced some degree of failure.

[27] Unfortunately, the pursuers did little to record the nature and extent of the defects at each site. There is only one photograph of part of one site available to the court. There are

no plans or other records of the affected areas. The only physical evidence of defects which was preserved were two square “turf” samples of surface dressing taken from one site. One of the turf samples taken was of a failed area. Dr Hardie’s evidence was that many, though not all, of the chippings in that sample had been lost. It was clear to her from the chippings which remained in the sample, and from the depth of the indentations left where chippings had come away, that there had not been proper embedment of the chippings in that sample.

[28] The evidence of the pursuers’ witnesses as to the failures was very general in nature, and the areas affected were identified by reference to surface dressing remedial works carried out (mainly) in the following summer season. The witnesses estimated that about 90% of the original work was redone.

[29] Mr Baxter saw all the sites in Angus. He indicated that chippings had come away from the binder. In his view the single photograph produced was typical of the problem. He had not noticed any signs of lack of embedment. In cross-examination he accepted that if the failure had in fact been patchy he would have regarded lack of embedment as a possible explanation. However, he thought that the scale of the failures and their occurrence across four council areas made that unlikely.

[30] In 2010 Mr Johnston had been the pursuers’ Project Agent in charge of the surface dressing in Angus, Dundee and Falkirk. He began flexible retirement in September 2010. He was called back by Mr Duncan in late November 2010 and asked to look at some of the sites in Angus, but at that time he did not detect any major problem. However in 2011 major problems did become apparent. He drove over every site in Angus, Dundee and Falkirk. The sites were badly rutted with excess binder and patches of chippings. In some areas the surfaces were “binder lean”. Mr Johnston indicated that remedial action “had to be devised to take account of all the variables”.

[31] Mr Duncan (who at the material time was Works Manager East) indicated that when Mr Johnston came out in November there was minor chipping loss over a small number of sites, but that in January 2011 there was a major problem. He indicated that most, but not all, sites failed, and that in some sites failure was confined to wheel tracks.

[32] Mr Mitchell was a Project Manager who was not directly involved in the works but who observed failed sites in Falkirk. He indicated that most of the chippings in the wheel tracks had stripped from the binder and that the centre of the road and the verges showed a large amount of chipping loss.

[33] The only direct evidence of the failures in Perth and Kinross came from Mr Foley (who at the time of the works was a Project Supervisor). He indicated that there the chippings were coming out of the binder but that the binder remained.

[34] One of the defender's witnesses saw some of the sites. Mr Robin Geddes (the defender's Sales and Materials Manager and Transport Manager) visited three or four of the Angus sites in early 2011. He observed that at those sites not all of the chippings had stripped loose. Stripping was confined to the tyre tracks. He attributed it to the cold winter weather and poor embedment of the chippings.

[35] In 2011 Nynas provided £165,000 worth of binder free of charge to the pursuers for remedial works to the 2010 surface dressing. That represented the value of the binder which had been supplied for the 2010 surface dressing works. The evidence of Mr Hardy and Mr Cranney was that the 2011 supply was a goodwill gesture in view of the long-standing customer relationship between the pursuers and Nynas. The evidence of both witnesses on this matter was rather guarded. During the evidence of Mr Cranney there was mention of a without prejudice agreement, but neither the circumstances which led to it nor its terms were disclosed. I formed the impression that both witnesses were being careful, perhaps

understandably, that the whole background circumstances giving rise to the supply were not divulged.

The Pursuers' Case

[36] The pursuers' case that there were breaches of the terms implied by sections 14(2) and 14(3) is premised upon the proposition that the failures of the surface dressing which occurred were caused by some characteristic of the chippings. They posit two such characteristics which they say were effective causes. In any case, they also contend that even if one or other or both of those characteristics were not effective causes the court should nonetheless conclude that some unidentified attribute of the chippings was an effective cause of the failures. They argue that that third course may be followed if the court concludes that all other possible effective causes may be eliminated.

The First Suggested Cause - "Dusting Up"

[37] This aspect of the pursuers' case was founded on the evidence of Mr Baxter. That was the only expert evidence which the pursuers offered in support of it. While Professor Airey made reference to the theory in his report, he clarified in his oral evidence that the issue fell outside his area of expertise and that he was not offering expert evidence in support of it. He did not know what the mechanism for dusting up was. The introductory witness for the pursuers, Mr Cranney, touched upon the matter during his evidence but I understood him simply to be outlining Mr Baxter's views. Mr Cranney is the pursuers' Depute Director (Operations) and has been employed by them in various capacities for 21 years. He is an experienced civil engineer and that experience includes road maintenance. He was not an independent expert witness however, and if he had been

purporting to give skilled opinion evidence I think that Mr Ellis' objection to it on the ground it was not independent would have been well founded. In any case Mr Cranney did not add in any material way to the explanation of the phenomenon which Mr Baxter gave. Mr Baxter's evidence was the foundation for the dusting up case.

[38] I turn then to that evidence. In the spring of 2011 Mr Baxter was instructed by the pursuers to report on the failures which had occurred. He prepared a number of reports. His evidence was that the mineralogy of rocks in the Sidlaw Volcanics made chippings from such sources susceptible to the absorption of moisture and resultant degradation and oxidation when they were stockpiled awaiting use. That process created a fine layer of dust around the chippings with the result that, when the chippings were spread in the bitumen binder, the binder adhered to the layer of dust and did not adhere properly to the chippings. He recollected encountering the phenomenon of dusting up with chippings from two quarries in the Sidlaw Volcanics, at Cunmont and Ethiebeaton. That had been three or four decades ago. Chippings had been in stockpiles for 6-8 weeks before their proposed use for surface dressing. Before use they had become very dusty - they had had to be discarded, at considerable cost to Mr Baxter's employer. In Mr Baxter's view the rock at Waulkmill had the same mineral characteristics as Sidlaw Volcanic rock. He considered that a brief geological report prepared by Karen Dalglish (Appendix 1 to 6/9 of process) supported that conclusion.

[39] In fact Ms Dalglish had been unaware of Mr Baxter's proposed use of her report, and she did not support his interpretation of it. He had focussed on a particular passage dealing on a very general basis with the mineralogy of the Sidlaw Volcanics. He had taken it out of context. The passage was not an accurate description of the mineralogy at Waulkmill, nor had Ms Dalglish intended it to be such a description. She did not endorse

the way it had been used by Mr Baxter, and she did not support his conclusions about the stone at Waulkmill. On the contrary, she considered Waulkmill stone's inherent susceptibility to weathering was low. She did not consider it possible that chippings would have dusted up in the way suggested by Mr Baxter over the course of a surface dressing season.

[40] I am in no doubt that Mr Baxter is convinced that the problem he experienced with aggregate from Cunmont and Ethiebeaton was attributable to an inherent susceptibility of that stone to dust up. He considered Waulkmill to be similar stone which would have the same susceptibility. However, even if Cunmont and Ethiebeaton stone have such susceptibility, in my opinion that does not demonstrate that Waulkmill stone also has that characteristic. Waulkmill is part of the Montrose Volcanics, not the Sidlaw Volcanics. The evidence showed that even neighbouring quarries can have significantly different mineralogy (and indeed that there can even be significant differences between different parts of the same quarry). Thus, for example, Dr Hardie's petrographic examination of quarried rock samples from Waulkmill, Boysack, Ardownie and Cunmont (7/15 of process) revealed that in quarries where the rock has the same broad classification (andesite), the rock was nonetheless not the same. There were slight differences in the chemical composition of the parent molten material at the time of its placement in the Lower Devonian Period. The rock within the four different areas had been subject to varied influential processes in the post-placement period, which had resulted in different degrees of alteration. Ms Dagleish observed that at Ethiebeaton there was evidence of reddened joint zones indicative of late stage hydrothermal alteration, expanding clay minerals (smectites) were present, and there was significantly more chlorite present than at Waulkmill.

[41] The expert evidence led by the defender demurred from the theory that dusting up could have occurred in the periods between the chippings being produced by the quarry and their being spread on roads. The geological and mineralogical experts were all impressive witnesses. Dr Reid was particularly impressive. His enthusiasm for his subject, and the fair and persuasive way in which he responded to questioning, were evident for all to see.

[42] I accept the evidence of the expert witnesses adduced by the defender that the strata worked at Waulkmill at the times of their inspections of the quarry was fresh (unweathered) and fairly uniform, and that the position is likely to have been the same at the time the aggregate sold to the pursuers was produced.

[43] In her petrographic examination of the Waulkmill stone in 2015 (7/15 of process) Dr Hardie identified the rock type as andesite, and she provided further specification of its mineralogical characteristics. She also spoke to her petrographic examination in 2016 (7/27 of process) of samples taken from the current production of stone at Waulkmill (comprising aggregate from the 10mm and 14mm stockpiles, as well as lumps, and a sample of 0-4mm "dust"). The aggregate samples were examined in their fresh state and after exposure under autumn and winter conditions for one month and three months. The samples showed only very minor surface changes over time in response to exposure. Such changes were of the sort to be expected of any stockpiled aggregate when exposed to weathering for a period of time. They involved slight irregularity of the surface combined with the local accumulation of fine particulate matter adhering to the surface. The fine particulate matter was not the result of oxidation of ferruginous minerals, but comprised loose minerals from within the aggregate (loosened by superficial and normal weathering and due to abrasion and attrition) as well as externally derived airborne and rain transported "dust". Dr Hardie also indicated

that samples of the aggregate collected from Waulkmill in August 2015 had been retained outside for two winters. They were examined microscopically by her on 9 February 2017 and there was no evidence of “dusting up”.

[44] Dr Reid considered that dusting up in the sense described by Mr Baxter - alteration by weathering when in a stockpile - would be likely to take many months or possibly longer in the case of Waulkmill aggregate. It was a very fresh unweathered lava. In his opinion it could not dust up because of exposure within a surface dressing season. If dusting up had occurred it would have been visible on the aggregate. The aggregate would also have felt noticeably gritty. Once in place in the binder the aggregate’s faces with the binder would not be exposed and they would not weather.

[45] I find the evidence of Ms Dalgleish, Dr Hardie and Dr Reid persuasive. They were the witnesses best qualified to speak to the mineralogy of the Waulkmill stone and whether or not it was susceptible to dusting up in the way and over the time period Mr Baxter suggested. All three rejected Mr Baxter’s thesis, as indeed did the defender’s expert witness on pavement engineering, Professor Knapton. Between them these four witnesses had a wealth of mineralogical and practical experience.

[46] It was common ground between the parties that there was no evidence that dusting up had actually occurred. The chippings were produced to meet demand for deliveries. They left the quarry very soon after crushing. They were “fresh” when delivered - clean and unweathered. Had they been dirty or dusty when delivered that would have been evident to the pursuers and they would have been returned (as indeed a very few dirty deliveries were). Had they dusted up when stockpiled by the pursuers that would have been detected before use. A hand inserted in the pile would have emerged covered in a dust. That had not

happened. Once delivered the chippings were used relatively quickly: within a matter of days in some cases and, generally, within a few weeks.

[47] For all of the foregoing reasons I am not satisfied on the balance of probabilities that any of the failures of the surface dressing were caused by dusting up.

[48] In reaching that conclusion I do not overlook the second Nynas test results. I accept the evidence of Mr Johnston that the sample he provided for this test was indeed Waulkmill aggregate. However, in my opinion the circumstances of the second test make it very doubtful indeed (i) as to how representative the sample was of the chippings supplied; and (ii) whether any reliable conclusions may be drawn from the results. The sample came from a quantity left in the open hopper of a spreader at the end of the 2010 surface dressing season. By March 2011 a long time had elapsed since its supply by the defender. There was no indication of any steps having been taken to ensure that it was preserved in good condition during that period. It is possible that it was subjected to significant abrasion and attrition, or exposure to the elements during the period between its supply and March 2011. In my view the test results are not reliable evidence which supports the theory that the chippings used dusted up between their supply and their incorporation in surface dressing.

The Second Suggested Cause – Stripping

[49] The second suggested cause of the failures was that the Waulkmill aggregate's mineralogy made it susceptible to stripping of the aggregate from the binder emulsion, particularly in the presence of water. This aspect of the pursuers' case was founded on the evidence of Professor Airey. That was the only expert evidence which the pursuers adduced in support of it.

[50] Professor Airey's report was 6/74 of process. His evidence was that he had experience of the bond between stone and bitumen and the process of breakage or stripping. As already noted, he indicated that he had no prior experience of consulting on road surface dressing failures, and that his opinion was purely academic and scientific. He explained that in his view a contributing factor to the failures of the surface dressing would have been adhesion loss (stripping) between the aggregate and the bitumen emulsion. He considered that the mineralogy of the Waulkmill aggregate was susceptible to water absorption. Dr Hardie's petrographic examination showed that the aggregate was andesite dominated by plagioclase feldspar. In his opinion recent research (in particular Zhang, J., Apeagyei, A., Airey, G.D., Grenfell, J.R.A., "Influence of aggregate mineralogical composition on water resistance of aggregate-bitumen adhesion.", *International Journal of Adhesion and Adhesives*, 2015, 62: 45-54; Horgnies, M., Darque-Ceretti, E., Fezai, H., Felder, E., "Influence of the interfacial composition on the adhesion between aggregates and bitumen: Investigations by EDX, XPS and peel tests", *International Journal of Adhesion and Adhesives*, 2011, 31 (5): 238-247; and Blackman, B.R.K., Cui, S., Kinloch, A.J., Taylor, A.C., "The development of a novel test method to assess the durability of asphalt road-pavement materials", *International Journal of Adhesion and Adhesives*, 2013, 42: 1-10) into moisture absorption and the adhesive properties of aggregates had revealed that certain key mineral phases such as feldspar (anorthite, albite and orthoclase) and quartz have a detrimental influence on moisture sensitivity and aggregate-bitumen adhesion. In the paper by Zhang *et al.* the effects of aggregate mineralogical composition on moisture sensitivity of aggregate-bitumen bonds were investigated using four aggregate types (two limestone (L1 and L2) and two granite (G1 and G2)), two types of bitumen (40/60 pen and 70/100 pen), and three mechanical tests: the peel test, the Pneumatic Adhesion Tensile Testing Instrument

("PATII") test, and the pull-off test, as a function of moisture immersion time. Retained strength was used as a measure of moisture sensitivity of aggregate-bitumen bonds. The results were analysed by relating aggregate moisture absorption and mineral composition to retained bond strength. The mineralogical composition of each was ascertained using Mineral Liberation Analyser ("MLA") scans. Chlorite and albite were the dominant minerals in G1 with a presence of 31.53% and 27.13% by weight. In G2, albite and anorthite were the predominant minerals (32.73% and 18.54% by weight). The Zhang paper authors opined that the most obvious difference between G1 and G2 was the anorthite content. The results showed strong correlations between aggregate mineral composition and moisture absorption. The authors concluded that the moisture absorption properties of the aggregates considered in the study depended strongly on certain key minerals including clay, anorthite and calcite. Strong correlations were found between mineral compositions, with clay and anorthite having strong negative influence. In Professor Airey's opinion the mineralogy of the Waulkmill aggregate was analagous to G2 in the Zhang study. He maintained that, while it had been described in the paper as a granite, it was "closer to an andesite than a pure granite". He accepted that G2 and Waulkmill aggregate had different crystalline structures. He also accepted that he had no expertise in mineralogy, and that geologists or mineralogists were better qualified to advise as to the aptness of the analogy. He agreed that the Zhang study had been a very limited study, and that it had not been designed to enable analogies to be drawn with other aggregates.

[51] Dr Reid and Dr Hardie gave evidence in response to Professor Airey's theory. Neither accepted that the analogy Professor Airey drew between G2 and Waulkmill aggregate was a valid or helpful one. Neither accepted that the research which

Professor Airey founded upon supported his conclusion that the mineralogy of the Waulkmill aggregate made it susceptible to water absorption and adhesion loss.

[52] Dr Hardie considered that the techniques which Dr Airey had used to determine the effects of moisture were novel. They were not the techniques in current use. More extensive testing would be required before the Zhang study findings could be relied upon. She clarified that while the Zhang analysis of G2 and her analysis of Waulkmill aggregate both provided percentages of anorthite content, that was because albite and anorthite were two end members of the plagioclase feldspar series and the usual way of recording typically complex patterns of feldspar species was as proportions of albite and anorthite. In reality the feldspar type in either andesite or granite was very unlikely to include anorthite. She considered that it was not possible to draw any useful analogy between G2 and the Waulkmill aggregate. It was too big a leap. The analogy did not make a great deal of sense.

[53] Dr Reid observed that the data set in the Zhang study was so limited that the suggested correlation between anorthite and adhesion loss could not be meaningfully extended even to other limestones or granites, never mind to other rock types with significantly different mineralogy, grain size and geological origin. At the very least further testing would be required to establish whether the correlation was a general rule even for granite, or just a coincidence.

[54] Dr Reid highlighted the differences between alkali feldspars and plagioclase feldspars. While alkali feldspars did not bind well with bitumen, that was not the case with plagioclase feldspars. The three end members of plagioclase feldspars are orthoclase, albite and anorthite. Dr Reid noted that anorthite almost never occurs on its own, but is always closely intergrown with albite, orthoclase and other minerals. That could be seen clearly in

the colour version of Figure 5 of the Zhang study. The development of feldspars could be highly complex, especially in large crystals, with much zoning, twinning and intergrowths of various kinds. It was thus difficult to assign significance to the proportion of one end member in terms of susceptibility to moisture. Factors such as overall crystal structure and degree of weathering were also likely to play a part in susceptibility of the aggregate-bitumen bond to moisture, but those factors were difficult to quantify at the scale of individual minerals.

[55] In Dr Reid's view the dominant mineral in the Waulkmill andesite aggregate was feldspar. It was almost entirely plagioclase feldspar which lay in the middle of the range between albite and anorthite, towards the calcium end of the labradorite zone. By contrast, the feldspar in G2 was towards the sodium end of the andesine zone. During cross-examination Dr Reid added that it was evident from the photographs in the Zhang study that G2 was predominantly alkaline feldspar: large pink alkaline features could be clearly seen. (At this point during cross-examination senior counsel for the pursuers briefly conferred with Professor Airey and then indicated that that was accepted). Dr Reid continued to explain that G2 was a coarse-grained rock which had crystallised slowly underground. He demonstrated how the large grain size and the pinkish alkali feldspars could be seen on the PDF version of Figure 11 in the Zhang paper. It was not an andesite. It looked like a granodiorite, which he described as being "not that far from a granite". On the other hand, the Waulkmill aggregate had a very different fine-grained crystalline structure, with smaller crystals which could only be seen microscopically.

[56] In Dr Reid's opinion, while the Zhang study demonstrated a statistical correlation between anorthite and loss of strength in the aggregate-bitumen bond for the granites and limestones which had been examined, the evidence did not provide a proper basis for the

paper's conclusion that anorthite was a detrimental aggregate mineral. That conclusion could not be extrapolated from the data. It was "bigging up" the results of what was otherwise interesting and useful research. Further testing would be needed before that conclusion could be drawn even in relation to granites. Moreover, there was simply no proper basis for Professor Airey's thesis that the results of the study could be applied by analogy to the Waulkmill aggregate. In addition to having an insufficient foundation, Professor Airey's thesis was very difficult to reconcile with actual industry experience of plagioclase feldspars which were widely quarried and used for road stone.

[57] Professor Airey's thesis was also rejected by Professor Knapton. In his view the Zhang study was open to the interpretation that the stiffness of the bitumen was more significant than the mineralogy of the aggregate. Figure 9 showed that the more flexible bitumen (B2) performed better following moisture conditioning than the stiffer bitumen (B1). He doubted whether the moisture conditioning replicated road surface conditions: road surfaces were designed so that water ran off. He was also inclined to place more reliance upon the PATTI and pull-up test results than on the peel test results. The first two tests were well-established conventional civil engineering tests. By contrast, use of the peel test was novel in this context. Even if the Zhang paper drew proper conclusions in relation to the aggregates tested, those conclusions could not properly be extended to other aggregates without further research. In Professor Knapton's view the analogy which Professor Airey sought to draw between G2 and the Waulkmill aggregate could not be supported having regard to their different compositions, but on that matter he would defer to geological and mineralogical expertise.

[58] Professor Airey did not seek to rely upon either of the Nynas tests in support of his thesis. He considered the TWIT test to be fairly unreliable and subjective. On the other

hand, Professor Knapton indicated that the TWIT test was the conventional industry test for measuring the adhesion between aggregate and binder. The test carried out in March 2010 (6/7 of process) confirmed that the Waulkmill aggregate performed very well indeed. There is no suggestion that the circumstances of that test were other than appropriate. In contrast, the circumstances of the later test (6/17 of process) raised significant questions as to whether it provided a reliable indication of the adhesion performance of the aggregate which had been supplied. The test was carried out eight months after the end of the 2010 surface laying season. There were real questions as to the conditions to which the aggregate had been subjected and exposed since its supply. In addition to exposure to the elements it was possible that there had been significant abrasion and attrition.

[59] I am not persuaded that Professor Airey's theory is well founded. I agree with Dr Reid that the limited data in the Zhang paper do not justify the paper's final broad conclusion that anorthite is a detrimental aggregate mineral. Further, in my opinion the similarity or otherwise of G2 and the Waulkmill aggregate is a matter which properly falls within the expertise of geologists and mineralogists. I am satisfied, for the reasons given by Dr Reid and Dr Hardie, that there are very significant differences between the two aggregates and that the analogy which Professor Airey seeks to draw between them is unsustainable.

[60] I agree with Professor Knapton that the first Nynas test provides a good indication of the adhesion qualities of the Waulkmill aggregate which was supplied, and that the circumstances of the second Nynas test make it an unreliable guide. It is unnecessary to decide whether his additional reservations about the Zhang study (*ie* over and above those spoken to by Dr Reid and Dr Hardie) are well founded.

[61] It follows that I am not satisfied on the balance of probabilities that the failures which occurred in the surface dressing were caused by susceptibility of the Waulkmill aggregate to strip from the binder.

The Third Way – Elimination of all other Possible Causes

[62] The pursuers submitted that if the court was not satisfied that the failures were caused by one or other of the suggested causes, it should nonetheless be satisfied that they were caused by some unknown characteristic of the aggregate which made it of unsatisfactory quality or unfit for the purpose of use in surface dressing on roads in eastern Scotland. All other possible causes could be eliminated, or at least eliminated as being initiating (as opposed to aggravating) causes. The evidence, though circumstantial, was sufficiently compelling to permit the necessary inference to be drawn. The scale of the failures had been catastrophic. They had not occurred in previous years or since. They had occurred in all four council areas, and different design and construction teams had been involved. Neighbouring councils which had experienced similar weather had only had a normal low level of failure. The Waulkmill aggregate was the only possible common factor which might explain the failures. Severe winter weather, and perhaps lack of proper embedment, may have contributed to the failures, but neither could have been an initiating cause. The only possible initiating cause was some feature of the aggregate.

[63] The submission came to this. Although the aggregate satisfied all relevant applicable industry standards for road surface dressing, and although the only specific mechanisms of failure of the aggregate which were posited may be rejected, the court should nonetheless hold that some unknown feature of the aggregate (as opposed to some other cause or causes, known or unknown) was the source of all of the failures of the surface dressing.

[64] The submission was a bold one. While it was ably advanced by senior counsel for the pursuers, I do not accept it. In my opinion, on the evidence the cause or causes of the failures have simply not been established.

[65] The context against which the submission was made is that the state of the evidence is unsatisfactory. The responsibility for that rests with the pursuers. There is a lack of detailed reliable evidence as to the precise nature and extent of the failures at each site. As already noted, the only document produced recording a failed area was a solitary photograph (within 6/9 of process) of part of one site in Angus. There were no plans or other written records documenting the nature and extent of each of the failures. The only physical evidence of the surface dressing which was preserved were two turf samples from one site. Professor Knapton did not have the advantage of seeing any of the sites, but he indicated that the photograph showed that different areas of the road appeared to have behaved differently, and that it would have been useful to know why. In his view the lack of appropriate recording and preservation of evidence relating to the defective areas was surprising. It made ascertainment of the cause of each failure problematic. I concur on both counts. Nor do I think that the oral recollections of Mr Baxter and the lay witnesses make up for the deficiencies in the evidence.

[66] There is no direct evidence supporting the proposition that an unknown characteristic of the aggregate was responsible for the failures. The adminicles of indirect evidence relied upon do not convince me that the inference the pursuers say should be drawn ought to be drawn. While the fact that catastrophic failures had not occurred with the relevant councils before 2010 or in the following year suggests that there may have been some different factor or factors which affected the outcome in 2010, I am very far from persuaded that I should conclude that the only possible different factor was the use of

Waulkmill aggregate. At least three of the councils did not follow recommended design guidance in 2010. The designs for surface dressing in previous years and for 2011 were not before the court. Given the fact that there were departures from design guidance in 2010 I am sceptical of the suggestion that all relevant design guidance was followed prior to 2010 (and, if it was not, I am not inclined to conclude on the evidence that the departures would have been identical to those in 2010). It was plain that the designs for the remedial works in 2011 were different, not least because they had to deal with significantly different road surfaces given the presence of binder from the 2010 works. Likewise I am not disposed to accept that construction factors would have been constant throughout. The evidence of embedment problems in 2010 suggests otherwise. A further difference is that in 2010 what was used was aggregate with a PSV of 60, whereas in previous years aggregate with a lower PSV had been used. It is well established that while higher PSV aggregates have better road hardness and anti-skid qualities than lower PSV aggregates, they are more liable to damage through attrition and abrasion and greater care is needed in that regard. Another obvious difference is that the weather was more severe in the winter of 2010/2011 than in the years before or in the year after. For the reasons outlined below, I do not think this difference can be dismissed, especially when regard is had to the possible cumulative effects of weather and other factors.

[67] In my opinion the state of the evidence is such that deciding the case on the burden of proof is the only just course for me to take (cf. *Rhesa Shipping Co S.A. v Edmunds (The Popi M)* [1985] 1 WLR 948, per Lord Brandon of Oakbrook at p. 956A). Where, as here, all relevant facts are not known, the sort of elimination process proposed by the pursuers appears to me to be inappropriate (cf. *The Popi M*, per Lord Brandon of Oakbrook at p. 956B). In any case, ultimately I am not satisfied that the proposition posited by the pursuers

is more likely than not to be true. In my opinion, on the evidence it is more sensible and just to conclude that the cause or causes of the failures of the surface dressing are unknown or unproven, than to say that an effective cause must have been some characteristic of the aggregate (*The Popi M*, per Lord Brandon of Oakbrook at p. 956C-D; *Palmer v Nightingale (t/a Andover Pest Control)* [2016] EWHC 2800 (TCC), [2016] 170 Con. LR 19, per Coulson J at para 50ff. and the authorities there discussed).

[68] Given my conclusions as to the state of the evidence it is unnecessary to embark upon a comprehensive exposition of each of the potential causes discussed during the proof. A number of candidates were identified: eg poor design of the surface dressing; a problem or problems with the binders used; defective construction; the severe weather over the winter of 2010/2011; or a combination of one or more such causes. It is sufficient to say that on the evidence I do not think it is possible to say either that one or more of these potential causes was an effective cause of the failures, or that all potential causes other than the one suggested by the pursuers may be eliminated as likely causes of all of the failures. However, I think it right to record certain findings I do feel able to make.

[69] Aspects of the design guidance in Road Note 39 (6th ed) were not followed by the designers in Angus, Dundee and Falkirk. Road hardness probes were not used at all to assess the roads in Dundee and Falkirk, and they were used in only a minority of cases in Angus. The hardness of the road is a critical factor affecting the surface dressing design. Failure to take it properly into account increases the likelihood of poor embedment and breakdown of the surface dressing. Mr Baxter's evidence at the proof was that he saw no signs of poor embedment, but he accepted that there may have been evidence of it which he did not note. I am not satisfied that this was a matter which he investigated thoroughly. The evidence of Dr Hardie, Robin Geddes, and Professor Knapton provides a plausible basis

for contending that at least some of the failures may have been attributable to poor embedment. Dr Hardie's evidence was that in the turf sample from the failed area many, though not all, of the chippings had been lost. It was clear to her from the chippings which remained, and from the depth of the indentations left where chippings had come away, that there had not been proper embedment of chippings in that sample. Robin Geddes' impression was that poor embedment was an issue because at the three or four sites he visited the stripping was in the tyre tracks. Professor Knapton thought that stripping mainly in tyre tracks could be indicative of an embedment problem. Mr Baxter saw the force in that (although he thought that stripping through lack of embedment was an unlikely explanation for the catastrophic scale of the failures). Professor Airey accepted poor embedment could have contributed to the failures.

[70] Professor Knapton, Professor Airey and Mr Baxter agreed that if there had been a lack of embedment severe weather would have exacerbated the problem. All three agreed that the internal cohesive bonds within the binders would not have fractured unless the "Fraass" or "Glass" temperature was reached. Mr Baxter dealt with this matter fairly briefly in his evidence. His reasoning appeared to be that any failure caused by the cold weather would only occur if there was failure of the bitumen binder because the Fraass point was reached. The pursuers' principal witness on this matter was Professor Airey. He opined that the adhesive bond between the binder and the aggregate would not have broken unless the temperature fell to the Fraass point. On the other hand, Professor Knapton opined that the binder would have become stiffer as the temperature dropped, and there could have been diminished adhesion between the binder and the aggregate, and failure, even if the Fraass point had not been reached. Professor Airey accepted that as the binder became

colder it would have become more brittle, but he did not think the adhesive bond would have been affected unless the temperature fell to the Fraass point.

[71] The unchallenged evidence of Mr Hardy was that the Fraass point for the binders used by the pursuers was “about -20 degrees C”. Accordingly, it seems unlikely that that point was reached at any of the surface dressing sites. On the other hand, I found Professor Knapton’s evidence as to the effect of temperature on the binder more convincing than the views of Professor Airey and Mr Baxter. I can see that in relation to internal cohesion of the binder the Fraass point indicates when fracture is likely to occur; but it does not follow that loss of adhesion between the binder and the aggregate may not occur until the same temperature is reached. Professor Knapton’s view that as the temperature dropped and the binder became stiffer the binder was likely to have become less adhesive to the aggregate impressed me as both rational and in accordance with common sense. Professor Knapton also had the advantage over Professor Airey of having greater practical experience of involvement with road dressing projects and disputes arising from road dressing failures. I am not persuaded that this possible cause of failure should be eliminated on the grounds of the limited and rather unsatisfactory evidence to the effect that other councils did not experience major problems despite the severe winter. Aberdeenshire Council had experienced similar temperatures but had had a low rate of failure of surface dressing (about 1%). Conversely, there was evidence from the defender’s Mr Gormley that in 2011 South Ayrshire Council had had to carry out major remedial work (60,000 square metres) to surface dressing which it had carried out in 2010. However, in neither case was the court provided with all the information which would have been necessary to properly assess the significance (or otherwise) of the relevant evidence (eg full design and

construction details for the surface dressing, records relating to the failures, the prevailing winter temperatures).

[72] In conclusion, I am not satisfied on the evidence (i) that the failures all had a common cause; or (ii) that all potential causes other than a problem with the aggregate may be eliminated; or (iii) that some characteristic of the aggregate was an effective cause of each of the failures. On the evidence the cause or causes of the failures have not been established.

Further Authorities

[73] During the course of submissions reference was also made to the following cases: *Slater v Finning Ltd* 1997 SC (HL) 8, per Lord Steyn at p. 19; *MacDonald v Pollock* 2013 SC 22, per the Opinion of the Court delivered by Lord Eassie at paras 33-34; *Drake v Harbour* [2008] EWCA Civ 25, [2008] 121 Con. L.R. 18, per Longmore LJ at para 15, Toulson LJ at paras 26-29; *Monarch Steamship Co Ltd v Karlshamns Oljefabriker AB* 1949 SC (HL) 1, per Lord Wright at p. 25; *County Bank Ltd v Girozentrale Securities* [1996] 3 All ER 834, per Beldam LJ at p. 848h -849c, per Hobhouse LJ at p. 857d-f; *Kennedy v Cordia (Services) LLP* 2016 S.C. (UKSC) 59, per the (joint) judgement of Lord Reed and Lord Hodge at paras 48, 51-53.

Conclusion and Disposal

[74] The pursuers have failed to prove their case. It follows that the defender is entitled to decree of absolvitor. Accordingly I shall sustain the defender's third and fourth pleas-in-law, repel the pursuers' first plea-in-law, and pronounce decree of absolvitor. I shall reserve meantime all questions of expenses.