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*Judgment: approved by the Court for handing down
(subject to editorial corrections)**

Delivered: 09/08/2017

IN THE HIGH COURT OF JUSTICE IN NORTHERN IRELAND

QUEEN'S BENCH DIVISION (COMMERCIAL)

BETWEEN:

B A KITCHEN COMPONENTS LIMITED

Plaintiff;

-and-

JOWAT (UK) LIMITED

Defendant.

WEATHERUP LJ

[1] The plaintiff is a manufacturer of kitchen cupboard doors based at Derryloran Industrial Estate, Cookstown, County Tyrone. The defendant is a supplier of adhesives based in Staffordshire, England. Mr Shaw QC and Mr J Dunlop appeared for the plaintiff and Mr Orr QC and Ms Curran for the defendant.

[2] The plaintiff claims against the defendant for damages for breach of contract, negligence, breach of statutory duty, misrepresentation and negligent misstatement in relation to the supply of adhesives to the plaintiff for use in the manufacture of the kitchen doors. The only issue for present purposes is whether the defendant is liable to the plaintiff.

[3] The plaintiff's product is an MDF vinyl wrap kitchen door. The components are a medium density fibre board substrate (MDF), a vinyl foil (PVC) and the adhesive. The adhesive is applied to the MDF surface by automated spraying and

allowed to dry. The PVC foil, which is ready primed on one surface, is preheated and vacuum formed on the MDF.

The plaintiff's evidence as to the background to the dispute

[4] The plaintiff's business was operated by Brian and Kieran McCracken from 1997. Kieran McCracken gave evidence for the plaintiff as follows. In 2003 the plaintiff installed automated production lines which included robotic spraying equipment to apply the adhesive and presses to apply the PVC to the MDF. A two part adhesive was used, namely an adhesive with a separate curing or hardening agent. The two part adhesive was not supplied by the defendant.

[5] The plaintiff's new equipment included two Cefla spraybotic machines. Operatives from Cefla attended the plaintiff's premises to train the plaintiff's operatives. Each spray machine was fitted with three Krautzberger automatic glue guns. Operatives from Krautzberger attended the plaintiff's premises to train the plaintiff's operatives. Burkle presses applied the PVC to the MDF.

[6] In March 2003, after the installation of the plaintiff's new production lines, representatives of the defendant approached the plaintiff with a proposal to supply to the plaintiff the defendant's one part glue known as Jowat 150.50. The defendant's representative in the UK was Simon Preston and the representative in Northern Ireland was Philip Bingham.

[7] Mr Preston and Mr Bingham visited the plaintiff's premises and viewed the new automated production lines, the robotic spraying equipment, the components used by the plaintiff and the manufacturing process. In April 2003 trials were conducted at the plaintiff's premises with Jowat 150.50 one part glue. The defendant's dispersion manual dated February 2000 stated the application amount of adhesive to be approximately 40-60g per square metre (wet) (depending on the surface).

[8] In May 2003 the plaintiff stopped using two part glue and commenced using Jowat 150.50 one part glue. Initially the application amount of adhesive was set by the plaintiff at 50g.

[9] In June 2005 the plaintiff became aware of other manufacturers who had used Jowat 150.50 one part glue having experienced delamination of the vinyl from the substrate. As a result the plaintiff increased the application amount of adhesive from 50g to 60g.

[10] From October 2005 the plaintiff began to receive a significant number of complaints that the PVC was detaching from the MDF in finished kitchen doors which had been produced using the Jowat 150.50 one part glue. The plaintiff increased the application amount of adhesive to 70g in December 2005.

[11] Meetings occurred between the plaintiff's representatives and the defendant's representatives. Tests were carried out. The cause of the problem of delamination was not resolved. By a report from the defendant in April 2007 the cause of the delamination was stated to be first of all the application of insufficient adhesive. Additional causes were stated to be factory conditions such as thermal stress or moisture. Further it was stated that another factor could be the substrates or their chemical components.

[12] The plaintiff stopped using Jowat 150.50 one part glue in May 2007.

The pleaded case

[13] The plaintiff's amended particulars of claim pleaded that the defendant, with knowledge of the plaintiff's manufacturing process, supplied an adhesive that was unsuitable and not fit for purpose and further was unsuitable and unfit for use with MDF or with the MDF used by the plaintiff or with MDF containing paraffin based hydrophobing elements.

[14] By its defence the defendant pleaded that the adhesive was suitable for use and fit for purpose if applied correctly and in sufficient quantities and that any delamination was a result of the plaintiff's failure to manufacture the doors properly or make proper use of the adhesive and in particular to apply sufficient adhesive.

The manufacturing process

[15] The manufacturing process involved the MDF doors being routed to produce the shape and design on the door. The routed door was cleaned and moved into an airtight chamber where the automated glue spraying occurred. The sprayed door then moved to the drying oven. The dried door then moved to the press where the PVC was applied in a closed temperature controlled area.

[16] Adrian Morrison was a Spraybotic Operative at the plaintiff's premises who oversaw the application of the adhesive by the robots. The spraying machine was pre-set to apply the required quantity of adhesive. The doors were laid flat and the adhesive spray guns make repeated passes up and down the doors. Mr Morrison checked the application of the adhesive by visual inspection, by a weight test applied twice daily and by a peel test on five or six doors daily. Stephen Richmond was a Supervisor of fourteen employees working on the production lines at the plaintiff's premises. He confirmed the testing procedures and that delamination did not amount to a problem before or after the use of Jowat 150.50 one part glue.

The plaintiff's expert evidence

[17] The plaintiff engaged an expert witness, Dr John Comyn, a polymer chemist specialising in adhesives. Dr Comyn's conclusion was that -

"Delamination is due to a defect in the adhesive, which is that it contains a copolymer which migrates by diffusion from the crosslinked polyurethane network."

[18] On this theory the copolymer constituent of the adhesive is the cause of the problem. The copolymer is not cross-linkable and during the curing process it remains in the polyurethane matrix of the cured adhesive. Thereafter it diffuses to the PVC adhesive interface and breaks down the bond.

[19] Dr Comyn agreed with the report of Professor John Watts, who had carried out x-ray photo-electron spectroscopy on the doors and had concluded that there was a possible migration of a component present either within the MDF or the adhesive. The component bearing unfunctionalised carbon atoms induced the formation of a weak boundary layer and subsequent failure of the bond.

[20] Dr Comyn rejected the report produced by the defendant in 2007 which attributed the failure to insufficient adhesive being used and the contribution from other factors such as moisture and thermal stresses in the plaintiff's factory and that the substrates could be partially responsible for the derogation of the bond line.

[21] Three other aspects of Dr Comyn's report may be noted. First, it was concluded that the reported times of failure of the doors of roughly two years were in keeping with his opinion as to the cause of the failures. Second, there was discussion of the diffusion of wax from the MDF. While accepting that alkanes from MDF diffuse into the adhesive and may alter its mechanical properties and somewhat weaken the bond, Dr Comyn did not accept that this was the basic cause of delamination. Third, reference was made to other proceedings undertaken against the defendant in relation to delamination in Malta and France and in particular to the report of Madame Isabelle Coco in the French proceedings.

[22] Dr Comyn later acknowledged that he had made a mistake in calculating the value of the diffusion coefficient for the copolymer. However he maintained that the mistake did not impact on his conclusions about the cause of delamination or the rate of diffusion to the interface.

The defendant's expert evidence

[23] The defendant engaged Dr Chris Chatfield as an expert witness. Dr Chatfield's conclusion was that -

"The mechanism by which progressive foil detachment occurs is believed to involve adhesive that has not been applied at its recommended thickness,

combined with the action on this adhesive of thermally induced stresses on the foil and bond weakening by wax that has migrated from the MDF into the adhesive layer. The influence of wax migration will depend on the source of the MDF and how it is manufactured.”

[24] Dr Chatfield rejected Dr Comyn’s conclusion on the basis that there was no evidence for the development of a concentration of copolymer at the failure interface.

[25] The experiments carried out by Dr Chatfield indicated that the adhesive failed cohesively, leaving adhesive on both faces of the MDF and PVC. It was noted that the MDF contained a paraffin hydrocarbon wax ingredient. The adhesive on the PVC after delamination contained infrared absorptions that coincided with those given by the wax constituent of the MDF. Such components were said to be well known for their adhesion reducing characteristics.

[26] He noted that the PVC foil was split on some of the doors indicating that foil performance was unsatisfactory. It was also stated that it was not possible to discount shortcomings in the manufacturing process as a contributory factor to the adhesive failures. These included failures in relation to adhesive thickness, a smooth adhesive film, the condition of the PVC, temperature levels and duration, timing, and laminate pressure.

[27] Apart from insufficient adhesive, Dr Chatfield identified two contributory factors to the failure of the doors, namely thermal stresses and wax migrating from the MDF. The thermal stresses would arise from the differences in the coefficients of thermal expansion between the hot PVC pressed to the MDF and further from the stretching of the PVC into the contours of the MDF where temperature is critical. Dr Comyn was of the opinion that if there was inadequate adhesive the delamination would occur much quicker than had occurred. Similarly, Dr Comyn dismissed the diffusion of wax as a factor as this was said to involve a very rapid process.

[28] In any event Dr Comyn expressed the opinion that if the Jowatt 150.50 one part glue could not resist the thermal stresses and the diffusion of wax from the MDF then it was unfit for purpose.

The engagement of a Court appointed expert

[29] The respective expert witnesses therefore disagreed as to the cause of delamination of the kitchen doors. The experts gave concurrent evidence at the hearing. The fundamental differences remained between the experts as to the cause of delamination. It was agreed that further testing may assist in determining the cause of delamination. The hearing was adjourned for the further testing to be undertaken. Many tests were completed. Further reports were produced, singly and jointly. Dr Comyn and Dr Chatfield maintained their respective positions.

[30] It was then determined that a Court appointed expert would be engaged to report on the cause of delamination of the kitchen doors. After a false start Dr R H Dahm was appointed and submitted a report to the Court. Dr Dahm rejected the conclusions of both Dr Comyn and Dr Chatfield. His conclusion was as follows -

“In my opinion failure takes place at the MDF surface. The adhesive is not able to penetrate sufficiently far into the chosen MDF surface to form, after the curing step, a sufficiently robust layer of fibre reinforced resin composite to withstand the delamination forces brought about by differential thermal expansion and the internal stresses particularly at routed depressions and corners where the foil is highly distorted.

During the curing stage at [about 70] degrees C, water will be driven out of the interfacial MDF layer and wax will melt and diffuse in the adhesive. Gradually over time water and wax will find their way back into the interface and by lubricating the fibres will cause these to be teased out of the surface with subsequent failure of the laminate. The fibres of course will be stuck to the residual adhesive on the PVC laminate.

It appears to me that either the adhesive is unsuitable because it does not penetrate, or the adhesive is unsuitable for the particular type of MDF board used, or the adhesive is not suitable for application by spraying.”

[31] Dr Dahm provided two supplements to his Court report, one a variation of the other, which contained further comments on his hypothesis. The reports referred to “.... the curing stage at 130 degrees C” but in evidence it was accepted that the temperature at the curing stage was about 70 degrees C, hence the square brackets in the quotation above. This difference did not alter the conclusion. While Dr Dahm suggested further testing it did not prove possible to undertake that further testing.

[32] Dr Dahm considered that neither of the experts had paid sufficient attention to identifying the locus of the failure and to the interaction of the adhesive with the MDF surface before, during and after the curing process.

[33] While agreeing with Dr Comyn’s theory, Dr Dahm was not willing to accept that the time to build up to failure of the bond could be calculated. Further he was concerned that the actions of the copolymer once it reached the interface would not necessarily result in failure of the bond. Testing by surface analytical techniques failed to establish the accumulation of uncrosslinked copolymer at the adhesive to PVC primer interface. The presence of adhesive in patches rather than as a continuous film was established by optical microscopy using iodine staining and infra-red microscopy and local thermo- mechanical analysis.

[34] In relation to Dr Chatfield's opinion Dr Dahm considered that it was relevant to examine the surface of the MDF and the interaction of the adhesive with that surface both before and during the curing.

[35] Dr Dahm noted that to render the PVC surface suitable for use with a water based adhesive the surface was chemically treated with a primer which was capable of forming a strong bond with the PVC but also capable of forming a strong bond with the adhesive. The adhesive must also be capable of forming a strong bond with the MDF. Unlike the PVC, or its primer surface, the MDF is not smooth but consists of a mat of fibres weakly bonded to each other by the resin used in its manufacture. This can present a problem in that the fibres can be teased out of the surface over time and this will be influenced by absorbed water or wax which can act as a lubricant for the fibres. To meet this problem the adhesive must be designed to penetrate well into the surface of the MDF. Dr Dahm considered that this penetration of adhesive was not achieved in the case of the delaminated doors.

[36] Dr Dahm was satisfied that the appearance of MDF fibres on the PVC from delaminated doors provided strong evidence for failure at the MDF surface.

[37] The plaintiff accepted Dr Dahm's report. The defendant did not. Dr Dahm gave evidence at the resumed hearing. Evidence was also given on behalf of the plaintiff by Adrian Morrison, the Spraybotic Operator, Stephen Richmond, the Supervisor and Kevin McCracken, a director of the plaintiff. Affidavit evidence was filed on behalf of the defendant. Armin Erb, head of technical services at the defendant's manufacturing base in Detmold in Germany, gave evidence for the defendant.

[38] Herr Erb recognised that there had been an industry wide delamination issue at a time and in his view up to 90% of the problems were caused by the application process. He considered a failure rate of 1% to 2% to be reasonable and agreed that a failure rate of 6%, as was the case with the plaintiff, would result in the customer not buying the product. He emphasised the importance of the production process and adherence to the requirements such as cleanliness, temperature, pressure, timing. It was accepted that no representative of the defendant who had attended the plaintiff's premises had reported any complaint about the plaintiff's process. Herr Erb rejected the adhesive being the cause of the delamination, as it was said not to be consistent with the high incidence of successful doors. In addition reliance was placed on the conclusion of Madame Coco in the French proceedings that the adhesive was compatible with use for the required purpose.

The composition of the adhesive

[39] The defendant was critical of Dr Dahm's hypothesis. First of all it was a hypothesis that was untested. Much time was taken up in seeking to obtain the

complete formula for the adhesive so that tests could be undertaken with the use of an identical adhesive.

[40] Dr Dahm's report described the adhesive Jowat 150.50 as an aqueous latex consisting of aqueous dispersion of a polyurethane, an acrylic copolymer, a protected isocyanate activator, water and some undisclosed additives the main function of which is to stabilise the latex.

[41] Dr Comyn described the actual composition of the adhesive with percent by weight as follows -

- (1) Anionic, high molecular weight, acquiesce polyurethane dispersion for heat activation 75.2%.
- (2) Anionic, aqueous styrene - acrylic copolymer dispersion free of plasticiser 10.3%.
- (3) Deionised water 3.2%.
- (4) Surface deactivated isocyanate cross-linker 4.9%.
- (5) Additives (stabiliser, defoamer, thickener, wetting agent, UV inhibitor) 7.1%.

[42] The defendant resisted disclosure of the composition of the 7% additives to the adhesive on the basis of commercial confidentiality. That being so the adhesive could not be replicated for the purpose of conducting tests.

The composition of the MDF

[43] Dr Dahm described the MDF as typically comprising 82% selected wood cellulose fibre, 10% resin binder most commonly an urea formaldehyde resin, 7% water, less than 1% paraffin wax and 0.05% of extractable formaldehyde. The mixture of fibre binder and wax is subjected to high pressure and temperature which activates the binder. The amount of binder is sufficient to hold the fibres in place to form a board but does not completely fill the interstices between them.

[44] Dr Dahm in his evidence indicated that the adhesive should perform two tasks in relation to the MDF, being first of all to strengthen the MDF surface and secondly to provide adherence to the PVC. He considered the defendant's adhesive to be unsuitable for use with MDF with a high wax content. The wax content of MDF may vary, the range being stated by Dr Dahn at 5% to 7% and by the defendant at 0.5% to 1%. The defendant's manual provided for the use of the adhesive with MDF without regard to wax content.

[45] Mr McCracken's evidence was that the plaintiff had the same four suppliers of MDF during the period of use of the defendant's adhesive and all MDF was to EU standard 6222-5. The defendant did not raise any issue with the suitability of the adhesive for the MDF being used by the plaintiff. Sample doors were sent by the plaintiff to the defendant for testing and no issue was raised as to the plaintiff's equipment or materials.

The adhesive as applied

[46] The defendant contended that tests carried out by independent laboratories demonstrated insufficient adhesive thickness and coverage over the surfaces. While the kitchen doors had good initial adhesion they developed the delamination on ageing. The laboratory tests showed that, after ageing, there was insufficient adhesive.

[47] The defendant complained about the absence of production records to show the proper application of the adhesive. Mr McCracken and the plaintiff's factory operatives gave evidence as to the operation of the automated adhesive spraying system. The Spraybotic Operatives monitored the plaintiff's robotic spraying operation under the supervision of the Supervisor. The operatives undertook visual tests to ensure sufficient coverage. The spraying equipment was pre-set to deliver the required quantity of adhesive. The operatives also carried out selective weight tests and peel tests whereby the PVC was pulled off the door to determine whether MDF fibres on the PVC demonstrated sufficient strength of adhesive.

[48] The defendant's dispersion manual dated February 2000 stated the application amount to be approximately 40-60g per square metre (wet) (depending on the surface). It is noted that the defendant's dispersion manual dated December 2011, although not applicable, indicated surface spray of 65-75g per square metre (wet) and an edges and profiles spray of 85-110g per square metre (wet).

[49] I accept their evidence and am satisfied that when applied in the factory the quantity of adhesive used was in compliance with that recommended by the defendant, being initially 50g and increased thereafter.

[50] Failure of the doors was at a rate of 6%. It was the plaintiff's evidence that this failure rate corresponded with the use of the defendant's adhesive between May 2003 and May 2007. This evidence is accepted.

The Maltese and French proceedings

[51] As far as the Maltese proceedings are concerned the evidence on behalf of the defendant was that the glue used in Malta was of a different composition to that supplied to the plaintiff. No assistance can therefore be obtained from these proceedings.

[52] As far as the French proceedings are concerned the composition of the glue was the same as that supplied to the plaintiff. The defendant emphasised that the report of Madame Coco in the French proceedings stated that in general the use of the defendant's one part glue Jowapur 150.50 was not intrinsically inappropriate. The plaintiff emphasised that Madame Coco's report also stated that the presence of water repellent compounds in the MDF (paraffin) led to part of the paraffin wax migrating in the glue joint and led to its deterioration.

Conclusion

[53] The Court must be satisfied that the plaintiff has discharged the burden of establishing that the defendant was in breach of a duty to the plaintiff and that the breach of duty caused the damage to the plaintiff, that is that the delamination of the plaintiff's doors resulted from the use of the adhesive supplied by the defendant. The standard of proof imposed on the plaintiff is the balance of probabilities. Definitive testing with the MDF and the PVC and the adhesive as used in the manufacturing process between May 2003 and May 2007 has not been possible. Records of the quality control of the production process are not available. The Court must proceed on the evidence available.

[54] On the basis of the available evidence the Court is satisfied on the balance of probabilities that Dr Dahm's hypothesis contains the explanation for the problem. The probable cause of delamination of the kitchen doors was that over time water and wax migrated to the MDF interface and lubricated the fibres and caused them to be teased out of the surface with resulting failure of the laminate. I am satisfied that the defendant failed to appreciate the significance of the wax content of the MDF and its overall effect on the adhesive.

[55] The defendant relied on the worldwide use of this adhesive without evidence of any fundamental weakness. The plaintiff relied on delamination problems encountered with the defendant's adhesive and not only in Malta and France. No doubt some of the other instances of delamination have been occasioned by inadequate production methods. However each instance would have to be examined to determine the particular problem. The plaintiff was said to have encountered delamination problems with other adhesives. However the evidence establishes that the rate of delamination with the defendant's adhesive at 6% was inordinate and unacceptable. Further the defendant relied on the 94% of doors successfully laminated as pointing away from the adhesive being the cause of delamination. The mechanism of delamination described by Dr Dahm relies on the unsuitability of the adhesive with high wax content. A variable will be the wax content.

[56] The defendant's representatives approached the plaintiff to promote their one part glue as suitable for use by the plaintiff. It was represented that it was suitable

for use in their existing process, subject to compliance with the defendant's specifications. The process involved the plaintiff's machinery, including the spraying equipment, newly installed, of which the defendant was complimentary. The process also involved the use of MDF and PVC, which the defendant represented could be adequately bonded with the defendant's one part glue. The defendant's specifications included the grammage, temperature and pressure to be applied during the process. I am satisfied that the defendant did not take any or adequate account of the presence of wax in the MDF. The plaintiff and the defendant undertook trials of the adhesive on the plaintiff's MDF and PVC before it was accepted by the plaintiff. No issue was raised about the use of MDF or the particular MDF used by the plaintiff. Variation of grammage or temperature or pressure was not stated by the defendant to be necessary because of the use of the MDF. No adjustment of the process was stated by the defendant to be necessary if Jowat 150.50 were to be accepted by the plaintiff in place of the two part glue then in use.

[57] It was an implied term of the contract between the plaintiff and the defendant that the adhesive supplied by the defendant would be suitable for use by the plaintiff with the MDF and PVC used by the plaintiff and with the equipment installed by the plaintiff, subject to the defendant's specifications. The defendant was in breach of contract in failing to have any or adequate regard to the effect of the presence of wax in the MDF. The failure to take account of the presence of wax in the MDF was the cause of the delamination of the doors. The defendant's breach was the cause of the damage to the plaintiff.

[58] I find for the plaintiff on liability.