IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

THE DOW CHEMICAL COMPANY, Plaintiff, v. NOVA CHEMICALS CORPORATION (CANADA) and NOVA CHEMICALS INC. (DELAWARE), Defendants.	)	C.A. No. 05-737 (JJF)

SECOND DECLARATION OF BENJAMIN S. HSIAO

I, Benjamin S. Hsiao, do declare and state as follows:

Educational Background

1. I am a chemistry professor and Chairman of the Chemistry Department at State University of New York at Stony Brook, where I have been a professor since 1997. I am also a Guest Professor at the Changchun Institute of Applied Chemistry at the Chinese Academy of Sciences. Additionally, I was an Adjunct Associate Professor in the Department of Materials Science and Engineering at the University of Delaware from 1994 to 2000. I have been the Chairman of the Chemistry Department since 2007.

2. In addition to lecturing, I conduct and supervise a large amount of research. My research interests include the fundamentals of polymer crystallization, behavior of orientation-induced crystallization and the structure/property/process relationship in nanostructured polymers, elastomers and nanocomposites.

3. I received a M.S. and Ph.D. from the Institute of Materials Science at the University of Connecticut in 1984 and 1987, respectively. Prior to receiving those degrees, I received my B.S. in chemical engineering in 1980 from National Taiwan University.

4. After receiving my Ph.D., I was a Post-Doctoral Research Fellow in the Departments of Chemistry and of Polymer Science & Engineering at the University of Massachusetts from 1987 to 1989. Following my post-doc, I became a Staff Scientist at the Pioneering Laboratory at DuPont Fibers from 1989 to 1993. Then, from 1993 to 1997, I worked as a Senior Staff Scientist in the Materials Science and Engineering Department at DuPont Central Research & Development.

5. I have been a member of numerous panels and organizations. I was a member of the Ad-hoc Advisory Panel for the Polymer Program of the Division of Materials Research for the National Science Foundation in 1997. I am currently a member of the Advisory Board of the American Chemical Society, Petroleum Research Foundation.

6. I am a member of editorial boards for several journals. I am a member of the Editorial Advisory Boards for Polymer, the Journal of Macromolecular Science - Physics, the Journal of Polymer Research, and Chinese Journal Applied Chemistry (Yingyong Huaxue). Additionally, I have been a member of the Executive Editorial Board for High Performance Polymers since 1996. Further, I was the Guest Editor for Journal of Macromolecular Science - Physics in 1998, and the Guest Editor for the Journal of Applied Crystallography in 2000.

7. I previously submitted a declaration in support of Dow's opposition to Nova's Motion for Judgment on the Pleadings. In the present declaration, I am addressing statements by Nova and by Dr. Charles Speed relating to Nova's argument that a person skilled in the art would not understand how to determine the slope of strain hardening or what units to use in calculating the slope of strain hardening coefficient (SHC).

8. First of all, I note that the term in the claims of the patents is "slope of strain hardening coefficient" not "slope of strain hardening." Therefore, first I will address whether a

person of skill in the art would understand how the phrase "slope of strain hardening coefficient" is defined. Then I will address Nova's argument that a person skilled in the art would not understand how the term slope of strain hardening is defined.

9. The specifications of U.S. Patent Nos. 5,847,053 and 6,111,023 (the "Dow Patents") define the SHC as follows: "The slope of strain hardening coefficient (SHC) is calculated according to the following equation: $SHC = (slope\ of\ strain\ hardening)*(I_2)^{0.25}$ where I_2=melt index in grams/10 minutes." ('053 patent, col. 6, lines 45-50; '023 patent, col. 7, lines 22-27). The term strain hardening was well known in the prior art in 1993. (*See, e.g., Mechanical Properties of Solid Polymers* (D.I. 24-2), Instron 1979 manual (Exh. C to Dow's Answering Claim Construction Brief), Instron 1983 manual (Exh. D to Dow's Answering Claim Construction Brief).) Strain hardening was a well known property seen in polymers put under a load test. There are many examples from the prior art showing the regions of the tensile curve, including the strain hardening region. For example, in a 1971 book published by the American Chemical Society entitled *Mechanical Properties of Solid Polymers*, a tensile curve for a polymer is included in the text at page 271. (D.I. 24-2.) This tensile curve, set forth below, illustrates the same strain hardening region referenced in the Dow Patents:

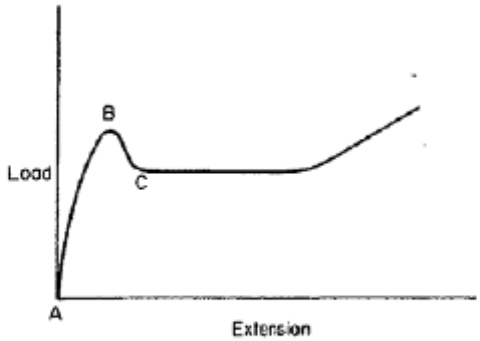


Figure 11.2. Typical load–extension curve for a cold-drawing polymer.

10. Furthermore, in 1993, it was also well known that in the strain hardening region, the tensile curve increases to a maximum slope indicating the region where strain hardening is the dominant effect and where the effects of strain hardening can be most clearly seen. Indeed, the patent itself indicates this well-known knowledge when it states that in the strain hardening region "occurs after the sample has pulled its initial load…and after the sample has gone through a slight drawing stage…" From this description from the patent alone, without any figures, a person skilled in the art would readily call to mind an image of a typical tensile curve of a polyethylene material undergoing strain hardening and such a person would readily call to mind an image of the strain hardening effect and the slope of the strain hardening curve in the strain hardening region. Indeed, such curves are shown in many basic textbooks, such as the one shown above. Consequently, just from this information alone, a person skilled in the art would readily understand the definition of the SHC that is set forth in the patent specification.

11. Nova and Dr. Speed present two arguments that a person skilled in the art would not understand aspects of how to measure the slope of strain hardening. First, Nova and Dr. Speed argue that a person skilled in the art would not know what units to use. Second, Nova argues that a person skilled in the art would not know what method to use to determine the slope.

12. Turning first to the issue of units, the description of the patent, as well as the examples in the patent and the prosecution history make it evident to a person skilled in the art what units to use--i.e., the units of load in pounds and extension in inches.

13. First of all, the patent provides a detailed discussion of the dimensions of the test sample to be used--all in inches--and the test conditions--1 inch minute--also in inches. These facts indicate that the units for slope would be English units--e.g., pounds, inches, etc.--and not metric units--kilograms, centimeters, etc.

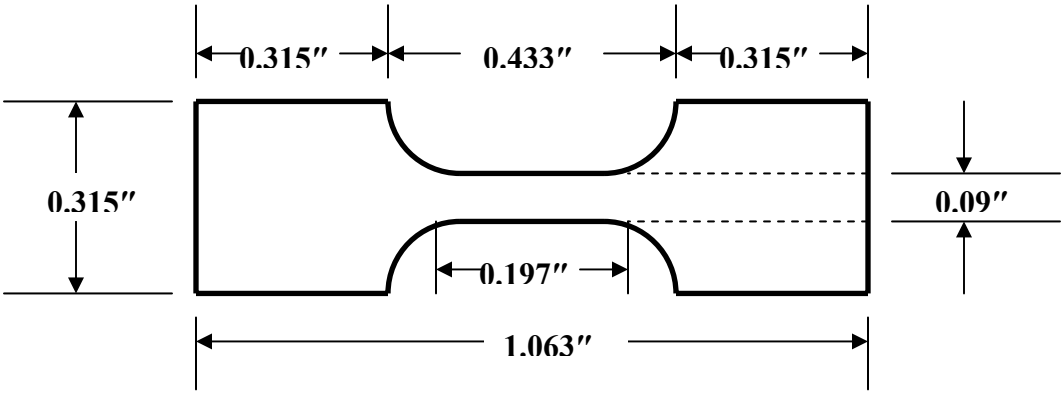
14. The patent also specifies that testing should be conducted in an Instron tensile testing device. In 1993, Instron tensile testers were well-known test equipment for determining tensile properties of polymers as well as other materials. The default parameters reported by the Instron testing equipment (both models 1125 and 4201) are units of load and elongation. When English units are used for these parameters, these are units of pounds and inches.

15. In addition the patent indicates that the data should be plotted using the load and the extension values obtained in the tests. The patent refers to stress strain curves; however, a person skilled in the art would understand that using the common usage in the art, there are two types of stress-strain curves. In one curve, the load is plotted against the elongation. In another, the stress in units of pressure is plotted against one of several different kinds of dimensionless units. There are also several kinds of stress and strain. For example, there is engineering stress (load divided by original cross-sectional area), true stress (load divided by actual cross-section area) as well as engineering strain and true strain. The term stress-strain curve is a generic term for all of these types of curves, including load-elongation curves. The patent explains that the strain hardening region occurs "after the sample has pulled its initial ***load*** ((*i.e.*, stress)…)…but with increasing ***elongation*** (*i.e.*, strain)…." This would indicate to a person skilled in the art that the load is being equated with the stress part of a stress/strain curve and the elongation is being equated with the strain part of such a curve. Furthermore, when specifying the properties of the strain hardening region, the patent again refers to load and elongation: "The load increases in the strain hardening region at a much lower rate than during the initial load region and the elongation also increases…."

16. Furthermore, if strain were to be used, a person skilled in the art would expect some guidance on what is called the gage length. Strain is a ratio of how much the sample has

stretched to the length of the relevant part of the original sample. The relevant part of the sample for purposes of strain is the part that undergoes the stretching. That part of the sample will not be the whole sample, because, for example, the tensile testing equipment grips the sides of the sample and the only parts of the sample in between the grips undergoes any stretching. Whenever strain is used, the gage length of the sample must be carefully identified. In fact, one of the Instron manuals states that "Establishing gage length is one of the most important decisions to be made when performing tension tests. Gage length is used as a basis for calculating percent elongation and in determining specimen strain rate, hence, it can seriously affect the test results." (Exh. D to Dow's Answering Claim Construction Brief at A-3). Choices of different gage lenghts affect the results of calculations one would conduct to convert elongation into strain. Thus the choice of gage length will affect comparisons one would make between SHC values if samples are tested using different gage lengths.

17. A person skilled in the art reviewing the patent would immediately recognize that the gage length in the patent could one of two dimensions. Shown below is a drawing (not to scale) prepared from the dimensions set forth in the patent:



Dogbone with dimensions as set forth in the patents

The patent states that the overall length of the dogbone is 1.063 inches and that thinnest part of the dogbone has a length of 0.197 inches. It states that each of the wide sides of the dogbone has a length of 0.315 inches--leaving 0.433 inches for the remainder of the dogbone. Either 0.197 0.433 inches could be used for the gage length of the sample.

18. Therefore, a person skilled in the art would understand that--if actual stress and strain were to be used instead of load elongation for determining the SSH, it would be necessary to use the same gage length that would have been used to determine the SSH in the patent. Because no gage length is clearly taught, that suggests that a gage length was not used to calculate the SSH values in the patent. Thus, a person skilled in the art would assume that actual stress and true values are not used to calculate SHC values in the patents but that instead, the default units of load and elongation were used.

19. A person skilled in the art would also immediately determine that the choice of units could easily be confirmed by selecting a polymer from the patent specificaiton or prosecution history with a reported SHC value, running a test on that polymer and rejecting any units that did not result in an SHC measurement close to the reported SHC value. For example, the patent includes over twenty examples with SHC values reported. A person skilled in the art who measured the SHC for these polymers if they used the correct units would obtain values that were of the same order as those reported in the patent, but, as Dr. Speed points out, if the wrong units are used, the values obtained would be more than 100 times off. Thus a person skilled in the art would immediately determine the correct units to use.

20. For example, the prosecution history reports a value of 1.2 for the slope of strain hardening for the polymer Exact 3027. This value was obtained using units of pounds versus

inches. According to the spreadsheet Mr. Markovich used to calculate these values, the relevant load and elongation data for the two points were as follows:

	Load value	Elongation value
First point	1.55165 pounds	2.4886 inches
Second point	2.33017 pounds	3.3953 inches

Mr. Markovich calculated the slope of strain hardening (SSH) using the standard formula for slope:

$$SSH = \frac{(2.33017 - 1.55165)}{(3.3953 - 2.4886)} = 0.8586$$

(DN____). The SHC is then calculated using the definition from the patent, as follows:

$$SHC = SSH * MI^{0.25} = (0.8586) * (3.26)^{0.25} = 1.2$$

21. If instead, stress in pounds per square inch versus different kinds of strain are used, the values for the two points of Exact 3027 are as follows:

	Stress value	Strain (gage length is 0.197)	Strain (gage length is 0.433)
First point	3448 psi	12.63	5.75
Second point	5178 psi	17.24	7.84

The stress is calculated using the cross-sectional area of the thinnest part of the dogbone, i.e., .005 inches times 0.09 inches, or 0.00045 square inches. The strain values are each calculated

for the two possible gage lengths discussed above with respect to the drawing of the dogbone referred to in the patent. The SSH and SHC values for each of these different gage lengths, using stress in psi and strain of the different gage lenghts are then as follows:

	gage length is 0.197	gage length is 0.433
SSH	375	828
SHC	503	1113

Thus, if stress vs strain are used, the values for the Exact 3027 polymer are 503 or 1113 depending on which gage length is used. These latter numbers are so far off of the reported value of 1.2 for the SHC of Exact 3027 that a person skilled in the art would immediately recognize that the default values--pounds versus inches--should be used. And metric units are even further off.

22. Similarly, Table 1 in the patent reports 22 samples of polymers made with Dow's single-site CGC catalyst. A person skilled in the art could obtain a polymer with similar properties or have one made and readily determine the SHC value. Once again, a person skilled in the art would immediately see that the units would have to be pounds vs. inches in order to obtain an SHC value even close to the values for these types of polymers reported in the patent.

23. For example, Dow's Affinity PL1840 polymer is a polymer with a melt index of about 1.0, a density of about 0.909 and an I_{10}/I_2 of about 10. While not identical to any polymer in Table I in the patent, it is close enough such that a person skilled in the art would expect it to have an SHC value of between about 1.3 and 2.0, based on similar polymers in the table.

24. Dr. Oswald, as noted by Dr. Speed, performed SHC testing on a sample of that Affinity PL1840 polymer. Dr. Oswald obtained values of around 1.44 for the SHC for that polymer using units of pounds versus inches, which is well within the ballpark of the values reported in Table 1.

	Load value	Elongation value
First point	0.2 pounds	0.2 inches
Second point	3.8 pounds	2.7 inches

This results in an SSH of 1.44. The melt index for Dr. Oswald's sample was 0.97. Consequently, the SHC is 1.43.

25. If instead, stress in pounds per square inch versus different kinds of strain are used, the values for the two points of PL1840 are as follows:

	Stress value	Strain (gage length is 0.197)	Strain (gage length is 0.4330029
First point	444 psi	1.02	0.46
Second point	8444 psi	13.71	6.24

The SSH and SHC values for each of these different gage lengths, using stress in psi and strain of the different gage lenghts are then as follows:

	gage length is 0.197	gage length is 0.433
SSH	630	1384
SHC	624	1370

Thus, if pounds per square inch versus strain are used, the values are hundreds or thousands of times higher than that--e.g., 624 or 1370, depending on which gage length is used.

26. Dr. Speed points this example and argues that Dr. Oswald supposedly calculated SHC using two different sets of units resulting in conflicting values, both near 1.3. However, there is no basis for Dr. Speed's conclusion. Dr. Speed points to two different graphs showing SSH calculations. One graph is included in Dr. Oswald's databook, and, as Dow has repeatedly stated, uses the units of pounds versus inches for the strain hardening slope. The other graph was not found in Dr. Oswald's databook. An analysis of this second graph shows it does not correctly calculate any stress values using the dogbone dimensions set forth in the patent at all is therefore irrelevant to what a person skilled in the art would understand from reading the patent.

27. As Dr. Speed states, the second graph is a stress/strain plot for the same sample as the first one. However, this graph--which Dr. Oswald did not include in his notebook--is obviously erroneous in its calculation of stress. The patent specifies that the thickness of "dogbone" used for testing is 0.005 inches. These dimensions result in a cross-sectional area for the sample of 0.00045 in^2. With this cross-sectional area, the stress corresponding to the points at the upper right side of the curve--which have a load of about 3.8 pounds--should be about 8444 psi. However, in the erroneous calculation that Dr. Speed relies on, the stress for points in this region are about 300 psi--more than 7,500 psi less than what the measurement should be if the stress were accurately calculated. Accordingly, this graph does not correctly reflect any units that could be obtained from the testing done on the dogbone of PL1840, but instead is at best an erroneous calculation based on those results.

28. Using those the correct values for the units of psi per inches per 100, the value for the SHC is 31.7, more than twenty times the value of 1.44 obtained by Dr. Oswald as shown in the following calculations. First, using the correct values for stress, the SSH is about 32:

$$SSH = \frac{(8444 - 444)}{(2.7 - 0.2)} / 100 = 32$$

The SHC value for this SSH is then about 31.7, using the equation to multiply the SSH by the melt index to the one-fourth power. Therefore, I conclude that the second graph from Dr. Oswald that Dr. Speed relied on was erroneous.

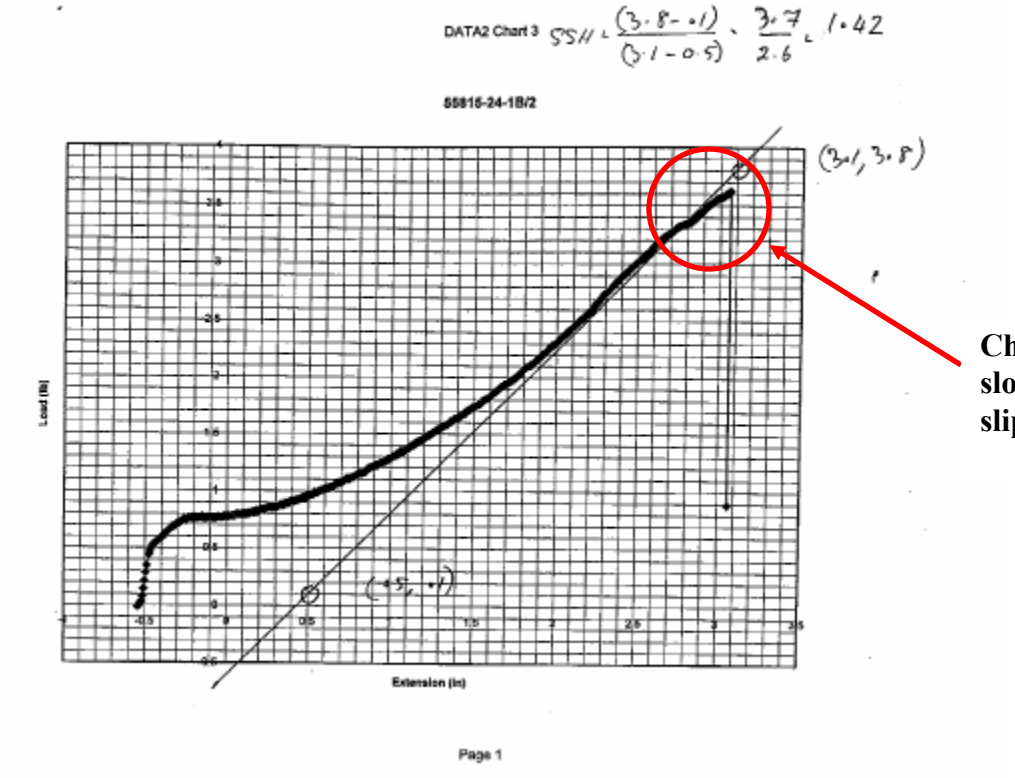
29. Second, Nova and Dr. Speed argue that the slope of strain hardening referred to in the definition of the SHC is unclear because a person skilled in the art would not know how to draw the line to determine the slope, even if the units were known and because there is no figure showing how to measure the slope. In my opinion, Nova and Dr. Speed are wrong on both arguments.

30. First, with respect to how to measure the slope of strain hardening, such a determination would have been readily understood by a person skilled in the art of the tensile properties of plastics in 1993. As just mentioned, from the description of the patent alone, without any figures, a person skilled in the art would readily call to mind an image of a typical tensile curve of a polyethylene material undergoing strain hardening and such a person would readily call to mind an image of the strain hardening effect and the slope of the strain hardening curve in the strain hardening region. Indeed, the strain hardening effect was one that was well known began to occur in the drawing region of the polymer, where the slope is very low. As the plastic is pulled further--through and beyond the drawing region--at first, for some polymers, there is a combination of drawing effects and strain hardening effects. During this phase, the slope of the tensile curve continues to increase. Then, when the phenomena that lead to drawing

are completed, then only strain hardening is occurring. This is evident in the tensile curve when the slope reaches a maximum and becomes more linear. For some polymers, the drawing effects are completed earlier than in others. So in some polymers the tensile curve becomes linear sooner than for others. But a person skilled in this area of polymer technology would readily understand that the point to measure the slope of strain hardening would have to be the point where the slope is at its maximum. Otherwise, if the slope is measured while the tensile curve is still arcing upwards, then the strain hardening of the polymer will be confounded with the drawing effect and the slope determined in that region will not be a slope of strain hardening at all. It would be a slope of drawing plus partial strain hardening.

31. Similarly, a person skilled in the art would understand that sometimes at the end of a tensile experiment, the sample slips in the machine or may rupture, resulting in a sudden reduction in the slope just before the break. These are called “end effects” and indicate the sample is approaching the end of the test when it will completely break. A person skilled in the art would know that this reduction in slope is not indicative of strain hardening at all, but is in fact an artifact of the test and should therefore not be included in the calculation of the slope of strain hardening.

32. Another effect that can occur just before sample breaks is the sample could slip in the testing equipment. When that happens, the slope abruptly drops as shown below:



This drop in slope does not reflect strain hardening. It reflects a side-effect of the testing that is common and well-understood. Thus, a person skilled in the art would not interpret this drop in slope as having to do with strain hardening, and would not use the slope of the drop as the slope of strain hardening. Thus, a person skilled in the art would use the maximum slope of the tensile curve in the strain hardening region as the slope of strain hardening. A person skilled in the art would also understand the test and how the equipment affects the sample. Such a person would also know the kinds of things that can go wrong and would be able to interpret unusual features in tensile curves. All of these would be taken into account by a person skilled in the art in deciding what method would be appropriate to use for determining the slope of strain hardening. Consequently, a person skilled in the art would readily understand what method to use for determining the slope of strain hardening.

33. Dr. Speed in his declaration at paragraphs 14 and 17 discusses five other methods that Dr. Speed says were used by Dow internally to determine the slope of strain hardening. However, these methods were not used by persons skilled in the art in 1993. I also understand that these were developed by Dow for use in quickly estimating the slope of strain hardening using automated techniques that could be applied without any expertise in tensile curve analysis. They are understood not to provide accurate values in all circumstance, whereas the maximum slope method would. And they would not be used by a person of ordinary skill in analyzing tensile curves unless it was clear that the problems caused by end effects, or other issues, would not affect the ability to determine the slope of strain hardening.

34. The problem with all of the methods except the maximum slope method is that a person skilled in the art would not consider these methods as accurately determining the slope of strain hardening, unless the curve was an ideal curve having no end effects or other issues. Instead, each of these methods suffers from the problem that, unless the slope is constant throughout the region these other methods are applied to, the slope these other methods determine will be confounded by other effects besides strain hardening. The other methods result in combining the slope of strain hardening with the slope caused by slipping of the sample in the holder. Thus, these other two methods do not accurately determine the slope of strain hardening at all, but instead determine a slope of the combined effects of strain hardening and sample slippage. This would have been readily apparent to a person skilled in the art and such a person would simply not have used any of the other five methods that Dr. Speed points to. Indeed, Dr. Oswald, the inventor of the 10% secant method for determining the slope of strain hardening, testified that the 10% secant method is not as accurate as the method of the patents-

in-suit--the maximum slope method--for this very reason. Instead, such a person would have determined the slope looking at the maximum slope of the curve shown in paragraph 15.

I declare under penalty of perjury that the foregoing is true and correct.



Date: August 27, 2008 Benjamin S. Hsiao

CERTIFICATE OF SERVICE

I, Rodger D. Smith II, hereby certify that on August 27, 2008, I electronically filed the foregoing with the Clerk of the Court using CM/ECF, which will send notification of such filing(s) to the following:

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I also certify that copies were caused to be served on August 27, 2008, upon the following in the manner indicated:

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