

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

TO M. W. Williams

AT Flemington

DATE Sept. 11, 1972

FROM W. C. Champion

AT Flemington

COPY TO Route List

SUBJECT CONOCO RESIN EVALUATIONS

OBJECTIVE: To compare Conoco PVC resins with similar Tenneco types.

SUMMARY

Nine samples of Conoco suspension resins, representative of seven product types, were compared with their Tenneco equivalents. Generally similar properties were found, with the only notable differences being gel count, electrical properties, particle size distribution, and color hold.

CONCLUSIONS AND RECOMMENDATIONS

1. The Conoco resins evaluated were equivalent to their Tenneco cognates except that they:
  - a. Exhibited lower electrical properties.
  - b. Had a large number of small gels.
  - c. Had a finer particle size distribution.
  - d. Gave somewhat poorer color hold in a semi-rigid clear compound.
2. Electrical properties appear to be a significant problem when considered in light of our current proportion of sales of electrical-grade resins and compounds. Possible corrective action for this problem should be discussed with Conoco personnel.
3. The higher gel count of the Conoco resins appears as small gels which are easily eliminated by additional working. The lot-to-lot variability seen should, however, be investigated through additional sampling.
4. Particle size distribution and early color hold are assumed to be correctable by known techniques in polymerization (e.g., adjustment of surfactant concentration, addition of antioxidant), but these approaches should also be discussed with, and confirmed by, Conoco personnel. The Conoco resin particle size distribution would not be acceptable to many of our customers under current requirements.
5. Sampling and evaluation of selected products should continue to establish lot-to-lot consistency.
6. One sample evaluated, Conoco 4385, is a "pearl"-type suspension resin, more properly compared with bulk polymerized

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resins. Although this product has some desirable performance characteristics, its cost compared with standard resins should be determined before further work is undertaken.

## DISCUSSION

### A. RESIN PROPERTIES

#### 1. PVC 225-Type Resins

Six Conoco 225 type resins (nominal specific viscosity = 0.38) were compared with typical lots of Tenneco 225/16R and 225-1. The Conoco resins were:

Conoco 5380 (S42097) - described as a calendering grade resin with fine particle size.

Conoco 5381 (S42242) - described as a fast dry-blending resin.

Conoco 5381 (H42020)

Conoco 5385 (D42001M) - used for pipe extrusion

Conoco 5385 "Bulk" - Oklahoma City plant production

Conoco 5386 - no data sheet available.

Table I summarizes the results of these comparisons.

The Conoco resins generally had acceptable dry-blending properties, high gel counts, poorer early color hold, and low volume resistivities, all as measured by our standard quality control tests. Where two lots of the same resin were available, consistency was apparently good within the same plant (Aberdeen, 5381), but poor between the two plants (Aberdeen and Oklahoma City, 5385). The variation noted in the latter case is of particular importance, since it was originally assumed that the D42001M lot was made in normal sized reactors, while the "Bulk" material was an example of Conoco's large reactor technology. During the recent meeting with Conoco in Piscataway, we were informed that all samples were made in large reactors (they have one at Aberdeen), making the observed differences in 5385 a plant-to-plant or lot-to-lot variation.

The gel counts reported, although quite high, are not felt to be a problem. These were observed to be small gels at 5 minutes of milling (standard Q.C. procedure) which are worked out with extended processing. Exhibits 1 through 9 show the effect of 5, 7, and 9 minutes of mill time on the gels in the Conoco resins - in all cases, the small gels had virtually disappeared by nine minutes, and the gel count was at an acceptable point. These observations were later supported by extrusion testing.

Quality Control heat stability measurements showed the Conoco resins to be poorer in early color development than the Tenneco controls. Since this phenomenon is formula dependent, a series of stability tests were run using Ba/Cd, Tin, and Lead systems. (Exhibits 10 through 12). In the Ba/Cd and Tin clears, the Conoco resins were generally found to be slightly poorer than the controls for color hold. This would only be a problem in rigid or semi-rigid clears, and should be easily correctable via common additive techniques (e.g., Ionol CP) during polymerization. In the Lead system, the 5380 and one lot of 5381 (542242) tended to "pink". This phenomenon should be investigated further. Dynamic (Brabender) stability testing is currently underway, and the results will be issued as an addendum to this report.

Brabender studies were done using the test resins in a wire insulation formula (Tenneco 2820) as a measure of processibility. Fluxing torques, equilibrium torques, and extrusion output rates were all within  $\pm 10\%$  and are felt to be equivalent.

Examination of optical and scanning electron microscope photomicrographs (attached) showed the Conoco resins to be generally similar in particle size and appearance to the Tenneco 225-1. No differences were noted between 5385/Aberdeen and 5385/Oklahoma City.

## 2. PVC 250-Type Resin

The sole example of a 250-type resin evaluated was Conoco 5446 (nominal specific viscosity = 0.44). This is described as an electrical grade resin, and Table II provides the results of the evaluation.

Again, the Q.C. results show poor electrical properties and high gel counts as compared with the Tenneco controls. Gel test investigation showed that the gel count was reduced by continued working (Exhibit 9). An observation confirmed in wire extrusion. The fine particle size of the Conoco resin is assumed to be correctable by process changes without sacrifice in other properties.

Although the Q.C. stability test suggests a difference, our lab tests (Exhibits 10 through 12) show Conoco 5446 to be equal to PVC 250-3. Processing characteristics as measured by the Brabender are also equal (i.e., within  $\pm 10\%$ ).

3. PVC 200-Type Resin

Data comparing Conoco 5300 (nominal specific viscosity = 0.30) with Tenneco 200-2 may be found on Table III. The Conoco resin has a fine particle size, poor dry flow, and an unexpectedly low bulk density. Gels were reduced by further milling. Adjustments in particle size and heat stability as previously noted, would be expected to bring this resin into a range comparable with Tenneco 200-2.

4. "Pearl"-Type Resin

Conoco 4385 (lot 541892) is a "pearl"-type resin, similar to those produced by Escambia or B. F. Goodrich (90-series). Table IV compares its properties with those of a normal, fast dry blend suspension resin, Tenneco 225-1. As shown by the screen analysis and photomicrographs (Figures 8 and 13) 4385 has very coarse, narrow particle size distribution. The SEM photographs reveal a porous surface, similar to that found in bulk polymerized resins, which accounts for the good dry-blending properties.

The poor volume resistivity of this resin suggests the use of an Ionic surfactant in achieving this porous particle. Brabender extrusion from powder shows lower output rates for the 4385 as compared with 225-1, but this is a probable result of the poorer resin dry-flow.

The Conoco 4385 is equivalent to Tenneco 225-1 in stability with barium-cadmium-zinc or tin systems. In Lead systems, a poor early color and a tendency toward gray rather than natural were noted.

B. FUNCTIONAL TESTING1. Wire Compounds

The Conoco resins assumed to be useful for wire extrusion were compared with Tenneco resins in Tenneco 2820, a THW compound. Formula and processing conditions may be found in Table V. Screw RPM was adjusted as noted to maintain the proper wall thickness. For the 225-types, the Conoco resins required a higher screw RPM than the Tenneco resins, indicating a lower output rate. For the 250's, the output rate was the same. The difference noted in screw RPM and motor load for the Burlington-produced material is probably attributable to the different particle size and shape.

Original physical properties determined on the wire show only the variation expectable from lot-to-lot or

due to the molecular weight differences. Room temperature I.R. results, on the other hand, confirm the differences seen in the resin V.R.s, with the Conoco resins having significantly poorer results. Although the UL specification for THW is only 200 megohms/1000 feet, most wire companies have internal specifications of 1000-1500 megohms. The low values seen with the Conoco resins would not afford a sufficient margin of safety for compound or resin sale, assuming variability in other raw materials such as plasticizer or filler.

Testing for aging properties, long term IR, and SIC change are underway, and will be reported later. Samples of the wire extruded are attached as Exhibit 13.

2. Pipe Compound

Fluxing and extrusion properties of Conoco 5385 (two lots), Tenneco PVC 225/16R (lot 222211) and Geon 103EP-F74 were compared in the Johns-Manville formulation. Fluxing, equilibrium torque, stability time, and processing were essentially equivalent. (Exhibit 14)

3. Flexible Clear Compounds

Two lots of Conoco 5385 (D-42001M and the "Bulk" sample) were compared with Tenneco 225 in a clear, tin stabilized semi-rigid compound. (Tenneco 3098 clear). Diamond 450, Stauffer SCC778, and Goodrich Geon 103EP were also used for comparators. Samples were milled for 2 minutes at 330°F and a 60-mil sheet obtained. One inch square chips were exposed in a forced air oven at 200°C. (Exhibit 15)

The two Conoco resins were inferior in color hold to the Tenneco control. Diamond 450 and Geon 103EP were poorer than the Conoco resins, while the Stauffer resin was better than the Tenneco control. This confirms a previous observation of the poorer early color-hold of Conoco 5385 in T/3098 (c.f., interoffice memo, J. W. McBroom to G. E. Disch, 6/7/72).

  
W. C. Champion

WCC/sbk

TABLE I  
CONOCO 225-TYPES

| Designation                                           | Conoco<br>5380 | Conoco<br>5381  | Conoco<br>5381  | Conoco<br>5385 | Conoco<br>5385 | Conoco<br>5386 | Tenneco<br>225/16R | Tenneco<br>225-1 |
|-------------------------------------------------------|----------------|-----------------|-----------------|----------------|----------------|----------------|--------------------|------------------|
| Lot No.                                               | S-42037        | S-42242         | S-42020         | D-42001M       | "Bulk"         | 42055          | (222211)           | (362090)         |
| CRE No.                                               | 840            | 848             | 849             | 851            | 850            | 852            | --                 | --               |
| Relative Viscosity                                    | 2.25           | 2.31            | 2.30            | 2.29           | 2.30           | 2.28           | 2.20               | 2.28             |
| Bulk Density, lbs./ft. <sup>3</sup>                   | 30.5           | 30.0            | 30.5            | 31.3           | 31.7           | 31.7           | 32.2               | 31.3             |
| Dry Blend Time, mins.                                 | 3.7            | 4.8             | 5.0             | 6.2            | 5.0            | 6.8            | 5.9                | 5.0              |
| Gels, $\sqrt{n}$                                      | 50+            | 45              | 3               | 14             | 50+            | 50+            | 6                  | 4                |
| Screen Analysis, %                                    |                |                 |                 |                |                |                |                    |                  |
| 45 mesh                                               | tr             | 0               | 0               | tr             | 0              | tr             | tr                 | 0                |
| 60 "                                                  | 2              | tr              | tr              | tr             | tr             | tr             | tr                 | tr               |
| 80 "                                                  | 10             | 5               | 2               | 11             | tr             | 21             | 26                 | 4                |
| 100 "                                                 | 32             | 37              | 53              | 63             | 44             | 64             | 66                 | 51               |
| 140 "                                                 | 75             | 86              | 91              | 90             | 92             | 89             | 87                 | 38               |
| 200 "                                                 | 95             | 100             | 100             | 97             | 100            | 100            | 98                 | 99               |
| Thru                                                  | 5              | 0               | 0               | 3              | 0              | 0              | 2                  | 1                |
| Funnel Flow, secs.                                    | 29.5           | 23.6            | 26.9            | 25.5           | 23.4           | 26.4           | 25.0               | 23.2             |
| V.R. ( $\times 10^{12}$ )                             | 4.4            | 8.3             | 6.5             | 16.8           | 11.8           | 9.4            | 24.5               | 30.2             |
| Brabender Roller (2220)                               |                |                 |                 |                |                |                |                    |                  |
| Flux Time (mins.)                                     | 3/4            | 1/2             | 1               | 1              | 1/6            | 0              | 1/4                | 1/2              |
| Torque @ 5 mins.                                      | 625            | 670             | 675             | 650            | 710            | 650            | 720                | 670              |
| @ 15 mins.                                            | 495            | 520             | 510             | 500            | 550            | 510            | 560                | 535              |
| Brabender Extrusion<br>(3:1 screw, 75 rpm, 1/16" rod) |                |                 |                 |                |                |                |                    |                  |
| Head Pressure                                         | 1550           | 1600            | 1600            | 1650           | 1600           | 1600           | 1650               | 1600             |
| Torque                                                | 2000           | 2000            | 2000            | 1900           | 2000           | 2000           | 2050               | 1900             |
| Output, gms./min.                                     | 64             | 63              | 63.5            | 67             | 66             | 63             | 67.5               | 64               |
| Heat Stability Rating                                 | -/110          | -/112           | -/112           | -/110          | -/97           | -/100          | --                 | +/122            |
| Contamination                                         | 7              | 7               | 8               | 36             | 6              | 10             | 8                  | 7                |
| Application                                           | Cal.           | Dry<br>Blending | Dry<br>Blending | GP, Pipe       | GP, Pipe       |                |                    |                  |

TABLE II  
CONOCO 250-TYPE

|                                                       | Conoco | Tenneco  | Tenneco  |
|-------------------------------------------------------|--------|----------|----------|
| Designation                                           | 5446   | 250-3    | 250-3    |
| Lot No.                                               | 42028  | (320002) | (320022) |
| CRE No.                                               | 841    | --       | --       |
| Relative Viscosity                                    | 2.51   | 2.51     | 2.47     |
| Bulk Density, lbs./ft. <sup>3</sup>                   | 28.8   | 30.7     | 31.0     |
| Dry Blend Time, mins.                                 | 5.4    | 5.6      | 5.6      |
| Gels, $\sqrt{n}$                                      | 50+    | 7        | 5        |
| Screen Analysis, %                                    |        |          |          |
| 45 mesh                                               | 0      | 0        | 0        |
| 60 "                                                  | tr     | tr       | tr       |
| 80 "                                                  | tr     | 8        | 16       |
| 100 "                                                 | 27     | 65       | 67       |
| 140 "                                                 | 81     | 95       | 93       |
| 200 "                                                 | 95     | 100      | 100      |
| Thru                                                  | 5      | 0        | 0        |
| Funnel Flow, secs.                                    | 27.5   | 26       |          |
| V.R. ( $\times 10^{12}$ )                             | 6.5    | 50.2     |          |
| Brabender Roller (2820)                               |        |          |          |
| Flux Time, mins.                                      | 0      | 0        | 3/4      |
| Torque @ 5 mins.                                      | 820    | 815      | 800      |
| @ 15 mins.                                            | 700    | 640      | 635      |
| Brabender Extrusion<br>(3:1 screw, 75 rpm, 1/16" rod) |        |          |          |
| Head Pressure                                         | 1950   | 1950     | 1850     |
| Torque                                                | 2100.  | 2250     | 2250     |
| Output, gms./min.                                     | 67     | 67       | 69       |
| Heat Stability Rating                                 | -/130  | --       | +/107    |
| Contamination                                         | 8      | 7        | 7        |

TABLE III  
CONOCO 200-TYPE

|                                     | Conoco  | Tenneco  |
|-------------------------------------|---------|----------|
| Designation                         | 5300    | 200-2    |
| Lot No.                             | M-41670 | (181082) |
| CRE No.                             | 847     | --       |
| Relative Viscosity                  | 2.05    | 2.03     |
| Bulk Density, lbs./ft. <sup>3</sup> | 29.7    | 34.4     |
| Dry Blend Time, mins.               | 6.9     | 6.8      |
| Gels, $\sqrt{n}$                    | 50+     | 5        |
| Screen Analysis, %                  |         |          |
| 45 mesh                             | 0       | 0        |
| 60 "                                | tr      | tr       |
| 80 "                                | tr      | 5        |
| 100 "                               | 1       | 44       |
| 140 "                               | 9       | 83       |
| 200 "                               | 84      | 100      |
| Thru                                | 16      | 0        |
| Funnel Flow, secs.                  | 40.2    | 23.5     |
| Heat Stability Rating               | -/86    | +/102    |
| Contamination                       | 7       | 7        |

TABLE IV  
CONOCO "PEARL" TYPE

|                                                       |                |                  |
|-------------------------------------------------------|----------------|------------------|
| Designation                                           | Conoco<br>4385 | Tenneco<br>225-1 |
| Lot No.                                               | --             | (362090)         |
| CRE No.                                               | 846            | --               |
| Relative Viscosity                                    | 2.23           | 2.28             |
| Bulk Density, lbs./ft. <sup>3</sup>                   | 33.7           | 31.3             |
| Dry Blend Time, mins.                                 | 4.3            | 5.0              |
| Gels, $\sqrt{n}$                                      | 17             | 4                |
| Screen Analysis, %                                    |                |                  |
| 45 mesh                                               | 1              | 0                |
| 60 "                                                  | 87             | tr               |
| 80 "                                                  | 95             | 4                |
| 100 "                                                 | 97             | 51               |
| 140 "                                                 | 99             | 88               |
| 200 "                                                 | 100            | 99               |
| Thru                                                  | 0              | 1                |
| Funnel Flow, secs.                                    | 20.1           | 25.2             |
| V.R. ( $\times 10^{12}$ )                             | 2.1            | 30.2             |
| Brabender Roller (2820)                               |                |                  |
| Flux Time, mins.                                      | 1/4            | 1/2              |
| Torque @ 5 mins.                                      | 620            | 670              |
| @ 15 mins.                                            | 480            | 535              |
| Brabender Extrusion<br>(3:1 screw, 75 rpm, 1/16" rod) |                |                  |
| Head Pressure                                         | 1450           | 1600             |
| Torque                                                | 1500           | 1900             |
| Output, gms./min.                                     | 61             | 64               |
| Heat Stability Rating                                 | -/115          | +/122            |
| Contamination                                         | 8              | 7                |

TABLE V  
WIRE EXTRUSIONS

| Resin Type<br>Lot No.    | 5380<br><u>S-42097</u> | 5381<br><u>S-42242</u> | T/225<br><u>222397</u> | 2820 Nat.<br><u>7-062483</u> | T/225<br><u>222211</u> | T/250-3<br><u>320002</u> | 5446<br><u>42028</u> |
|--------------------------|------------------------|------------------------|------------------------|------------------------------|------------------------|--------------------------|----------------------|
| <u>Prodex Conditions</u> |                        |                        |                        |                              |                        |                          |                      |
| Barrel Zone 1, °F        | 310                    | 310                    | 310                    | 310                          | 310                    | 315                      | 315                  |
| 2                        | 350                    | 350                    | 350                    | 350                          | 350                    | 355                      | 355                  |
| 3                        | 340                    | 340                    | 340                    | 340                          | 340                    | 350                      | 350                  |
| 4                        | 360                    | 360                    | 360                    | 360                          | 360                    | 365                      | 365                  |
| Die                      | 350                    | 350                    | 350                    | 350                          | 350                    | 355                      | 355                  |
| Screw                    | 135                    | 135                    | 135                    | 135                          | 135                    | 135                      | 135                  |
| Screw RPM                | 42.5                   | 42.5                   | 35                     | 40                           | 37.5                   | 40                       | 38                   |
| Motor Load, %            | 50                     | 50                     | 50                     | 56                           | 50                     | 50                       | 53                   |
| Head Pressure            | 1000                   | 1150                   | 1100                   | 1000                         | 1000                   | 1150                     | 1200                 |
| Rate, FPM                | 350                    | 350                    | 350                    | 350                          | 350                    | 350                      | 350                  |
| Wall Thickness, mils     | 46                     | 45                     | 44                     | 46                           | 45                     | 45                       | 46                   |
| <u>Wire Properties</u>   |                        |                        |                        |                              |                        |                          |                      |
| Tensile Strength         | 2660                   | 2835                   | 2725                   | 2935                         | 2775                   | 2975                     | 2845                 |
| 100% Modulus             | 1800                   | 1870                   | 1750                   | 1815                         | 1745                   | 1830                     | 1810                 |
| Elongation               | 245                    | 245                    | 265                    | 305                          | 275                    | 285                      | 260                  |
| I.R. @ 62.5°F, 14 hrs.   | 1850                   | 2125                   | 6250                   | 8500                         | 6500                   | 7000                     | 1775                 |
| I.R. @ 82°C, 14 hrs.     | 1.58                   | 1.88                   | 2.48                   | 1.70                         | 2.0                    | 1.75                     | 1.15                 |

Formulation: Tenneco 2820

|                     |      |
|---------------------|------|
| Resin               | 100  |
| Camelwite           | 10   |
| #33 Clay            | 18   |
| Tribase XL          | 6    |
| DTD                 | 26   |
| DIDP                | 26   |
| Fused Lead Stearate | 0.35 |

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The following figures and exhibits are attached to M. W. Williams' copy of this report:

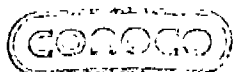
|        |    |                               |                           |
|--------|----|-------------------------------|---------------------------|
| Figure | 1  | Photomicrograph, 33X, Conoco  | 5385, Lot D-42001         |
|        | 2  | "                             | " 5381, Lot 42242         |
|        | 3  | "                             | " 5385, "Bulk"            |
|        | 4  | "                             | " 5300, Lot 41670         |
|        | 5  | "                             | " 5386, Lot 42055         |
|        | 6  | "                             | " 5381, Lot H-42020       |
|        | 7  | "                             | " 5446, Lot 42028         |
|        | 8  | "                             | " 4385, Lot S-41892       |
|        | 9  | "                             | " 5380, Lot S-42097       |
|        | 10 | "                             | Tenneco 225-1, Lot 362090 |
|        | 11 | SEM Photomicrographs, Tenneco | 225-1                     |
|        | 12 | "                             | " 250                     |
|        | 13 | "                             | Conoco 4385               |
|        | 14 | "                             | " 5385                    |
|        | 15 | "                             | " 5385 "Bulk"             |

|         |    |                                 |                           |
|---------|----|---------------------------------|---------------------------|
| Exhibit | 1  | Gel Testing:                    | PVC 225, Lot 222211       |
|         | 2  | "                               | PVC 250-3, Lot 320022     |
|         | 3  | "                               | Conoco 5380, Lot S-42097  |
|         | 4  | "                               | Conoco 5381, Lot S-42242  |
|         | 5  | "                               | Conoco 5381, Lot H-42020  |
|         | 6  | "                               | Conoco 5385, Lot D-42091M |
|         | 7  | "                               | Conoco 5385 "Bulk"        |
|         | 8  | "                               | Conoco 5386, Lot 42055    |
|         | 9  | "                               | Conoco 5446, Lot 42028    |
|         | 10 | Oven Heat Stabilities -         | Ba/Cd/Zn System           |
|         | 11 | "                               | - Tin System              |
|         | 12 | "                               | - Lead System             |
|         | 13 | Wire Extrusions                 |                           |
|         | 14 | Pipe Compound Brabender Testing |                           |
|         | 15 | Heat Stability -                | Tenneco 3098              |

APPENDIX I

CONOCO PRODUCT

DATA SHEETS



## Technical data

### CONOCO 5300

Conoco 5300 is a medium low molecular weight homopolymer resin specifically designed for molding application; This resin is a hot dry blend resin.

#### Resin Properties:

|                                                                      |                         |
|----------------------------------------------------------------------|-------------------------|
| Nature of Resin .....                                                | Dry free flowing powder |
| Bulk Density, lbs./cu. ft. ....                                      | 33 ± 3                  |
| Specific Viscosity, 0.4 g.<br>in 100 ml Nitrobenzene<br>@ 25°C ..... | 0.30 ± 0.02             |
| ASTM D1755-60T Classification .....                                  | GP2-25200               |

The above data are based on tests and experience which Continental believes reliable and are supplied for informational purposes only. Continental disclaims any liability for damage or injury which results from the use of the above data and nothing contained therein shall constitute a guarantee, warranty or representation (including freedom from patent liability) by Continental with respect to the data, the product described or their use for any specific purpose, even if that purpose is known to Continental.

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CONOCO 5300

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CONOCO 5300

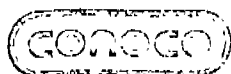
INT

Conoco 5300 is an intermediate molecular weight resin, finding applications in injection molding or extrusion. Shoe components are an example of the former while rigid or semirigid profiles of various kinds represent the latter. The preferred particle size distribution for these outlets has been toward the fine side.

TYPICAL PROPERTIES

INT PROTOLYSE, ANDREWS PLANT

|                                            |      |
|--------------------------------------------|------|
| Specific Viscosity<br>ASTM D1243, Method B | 0.30 |
| Bulk Density, lbs/cu. ft.                  | 32.8 |
| Sieve Analysis, % Retained on:             |      |
| 40                                         | 0    |
| 60                                         | 0    |
| 80                                         | 1    |
| 100                                        | 3    |
| 140                                        | 25   |
| 200                                        | 45   |
| p20                                        | 26   |
| Volatiles Content, %<br>110°C, 1 hr.       | 0.3  |



## Technical data

### CONOCO 5380

Conoco 5380 is an intermediate molecular weight, hot blending, electrical grade resin designed for calendaring, custom compounding, rigid and electrical extrusions.

#### Specifications:

|                                                          |                         |
|----------------------------------------------------------|-------------------------|
| Nature of Resin .....                                    | Dry free flowing powder |
| Particle Size, % through #20 mesh .....                  | 100                     |
| Bulk Density, lbs./cu. ft. ....                          | 29 ± 3                  |
| Specific Viscosity, 0.4% in<br>Nitrobenzene @ 25°C ..... | 0.38 ± 0.01             |
| Volatile Content, % Maximum .....                        | 0.5                     |
| ASTM D1755-60T Classification .....                      | GP4-25300               |

The above data are based on tests and experience which Continental believes reliable and are supplied for informational purposes only. Continental disclaims any liability for damage or injury which results from the use of the above data and nothing contained therein shall constitute a guarantee, warranty or representation (including freedom from patent liability) by Continental with respect to the data, the product described or their use for any specific purpose, even if that purpose is known to Continental.

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CONOCO 5380

1BT

Conoco 5380 finds its major application in calendering, where its finer particle size, relative to extrusion grade resins, gives it some distinct advantages.

TYPICAL PROPERTIES

OKLAHOMA CITY PLANT PRODUCTION

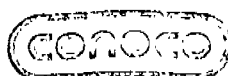
|                       |      |
|-----------------------|------|
| Specific Viscosity    | 0.38 |
| ASTM D-1243, Method B |      |

|                           |      |
|---------------------------|------|
| Bulk Density, lbs/cu. ft. | 30.3 |
|---------------------------|------|

Sieve Analysis, % Retained on:

|     |    |
|-----|----|
| 40  | 0  |
| 60  | 0  |
| 80  | 5  |
| 100 | 38 |
| 140 | 36 |
| 200 | 16 |
| pan | 5  |

|                      |      |
|----------------------|------|
| Volatiles Content, % | 0.15 |
| 110°C, 1 hr.         |      |



## Technical data

### CONOCO 5381

Rapid dryblending and an intermediate molecular weight are the characteristics of Conoco 5381 which make it a choice among extrusion and calendering convertors.

#### Specifications:

|                                                          |                         |
|----------------------------------------------------------|-------------------------|
| Nature of Resin .....                                    | Dry free flowing powder |
| Particle Size, % through 40 mesh .....                   | 100                     |
| Bulk Density, lbs./cu. ft. ....                          | $31 \pm 3$              |
| Specific Viscosity, 0.4% in<br>Nitrobenzene @ 25°C ..... | $0.38 \pm 0.02$         |
| Volatile Content, % Maximum .....                        | 0.5                     |
| ASTM D1755-60T Classification .....                      | GP4-15343               |

The above data are based on tests and experience which Continental believes reliable and are supplied for informational purposes only. Continental disclaims any liability for damage or injury which results from the use of the above data and nothing contained therein shall constitute a guarantee, warranty or representation (including freedom from patent liability) by Continental with respect to the data, the product described or their use for any specific purpose, even if that purpose is known to Continental.

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COLORITE 007181

# RESIN DATA SHEET

CONOCO 5381

LRT

Conoco 5381-LRT is a medium molecular weight homopolymer resin. It is designed to be faster in plasticizer absorption than conventional general purpose resins, and is, therefore, well-adapted to those applications involving rapid blending cycles or higher plasticizer levels.

## TYPICAL PROPERTIES

### OKLAHOMA CITY PLANT PRODUCTION

|                                                           |      |
|-----------------------------------------------------------|------|
| Specific Viscosity<br>ASTM D1243, Method B                | 0.38 |
| Bulk Density, lbs/cu. ft.                                 | 30.5 |
| Plasticizer Dry Time, Sec.<br>Conoco Test 17A, Using DIDP | 320  |
| Sieve Analysis, % Retained on:                            |      |
| 40                                                        | 0    |
| 60                                                        | 0    |
| 80                                                        | 20   |
| 100                                                       | 40   |
| 140                                                       | 30   |
| 200                                                       | 9    |
| pan                                                       | 1    |
| Volatiles Content, %<br>116°C, 1 hr.                      | 0.15 |



## Technical data

### CONOCO 5385

For critical applications requiring an intermediate molecular weight homopolymer polyvinyl chloride resin which exhibits exceptionally low gel count, good plasticizer absorption and rapid dry blend cycles, excellent extrusion hopper flow, clarity in end product, Conoco 5385 is the natural choice of converters.

#### Specifications:

|                                     |                         |
|-------------------------------------|-------------------------|
| Nature of Resin .....               | Dry free flowing porous |
| Particle Size                       |                         |
| % through 40 mesh .....             | 100                     |
| % through 200 mesh, maximum .....   | 4                       |
| Bulk Density, lbs./cu. ft. ....     | 30 $\pm$ 3              |
| Specific Viscosity, 0.4% in         |                         |
| Nitrobenzene @ 25°C .....           | 0.38 $\pm$ 0.01         |
| Volatile Content, % Maximum .....   | 0.5                     |
| ASTM D1755-60T Classification ..... | GP4-15343               |

CONOCO

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CONOCO 5335

ERT

Conoco 5335-ERT has been produced in multimillions of pounds for pipe extrusion. It is basically a versatile resin, however, and can be used in a variety of flexible as well as rigid extrusion applications.

TYPICAL PROPERTIES

OKLAHOMA CITY PLANT PRODUCTION

|                                                     |      |
|-----------------------------------------------------|------|
| Specific Viscosity<br>ASTM D1248, Method B          | 0.38 |
| Bulk Density, lbs/cu. ft.                           | 30.5 |
| Plasticizer Dry Time, Sec.<br>Conoco Test 17A, B1BT | 450  |
| Sieve Analysis, % Retained on:                      |      |
| 40                                                  | 0    |
| 60                                                  | 0    |
| 80                                                  | 30   |
| 100                                                 | 40   |
| 140                                                 | 22   |
| 200                                                 | 7    |
| pan                                                 | 1    |
| Volatiles Content, %<br>110°C, 1 hr.                | 0.15 |



## Technical data

### CONOCO 5446

PVC 5446 is an electrical grade homopolymer resin developed by the Conoco Plastics' resin chemists to give somewhat shorter blending cycles in high speed mixing equipment.

Extrusion rates of typical filled wire compounds prepared with 5446 have extruded 20% to 25% faster at the same screw speed than competitive resins of similar specific viscosity.

#### Specifications:

|                                |                         |
|--------------------------------|-------------------------|
| Nature of Resin                | Dry free flowing porous |
| Particle Size                  |                         |
| % through 40 mesh              | 100                     |
| % through 200 mesh max         | 4                       |
| Bulk Density, lbs./cu. ft.     | 30 ± 3                  |
| Specific Viscosity, 0.4% in    |                         |
| Nitrobenzene @ 25°C            | 0.44 ± 0.01             |
| Volatile Content, % Maximum    | 0.5                     |
| ASTM D-1755-60T Classification | GP5-15343               |

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CONOCO 5446

CONOCO 5446

LRT

Conoco 5446 is a high molecular weight PVC with a special capacity for rapid dry blend applications such as wire and cable coating. It finds other uses where the extra physical properties derived from its high molecular weight are important to the final product.

TYPICAL PROPERTIES

LRT PROTOTYPE, ABERDEEN PLANT

|                                            |      |
|--------------------------------------------|------|
| Specific Viscosity<br>ASTM D1243, Method B | 0.44 |
|--------------------------------------------|------|

|                           |      |
|---------------------------|------|
| Bulk Density, lbs/cu. ft. | 30.0 |
|---------------------------|------|

|                                                     |     |
|-----------------------------------------------------|-----|
| Plasticizer Dry Time, Sec.<br>Conoco Test 17A, DIDP | 315 |
|-----------------------------------------------------|-----|

Sieve Analysis, % Retained on:

|     |    |    |
|-----|----|----|
| 40  | 0  | 0  |
| 60  | 0  | 0  |
| 80  | 10 | 10 |
| 100 | 35 | 45 |
| 140 | 45 | 70 |
| 200 | 8  | 92 |
| pan | 2  | 2  |

|                                      |      |
|--------------------------------------|------|
| Volatiles Content, %<br>110°C, 1 hr. | 0.15 |
|--------------------------------------|------|

APPENDIX II

CONOCO QUALITY CONTROL

PROCEDURES

(Attached to M. W. Williams'  
Copy Only)