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# APPENDIX A

## THE RESULTS OF THE PROPERTIES TEST OF COMPOUNDED HDPE

| Formular | MFR (g/10min) | | | Lightness Index | | | O.I.T. (min) | | |
|---|---|---|---|---|---|---|---|---|---|
| | pass 1 | pass 3 | pass 5 | pass 1 | pass 3 | pass 5 | pass 1 | pass 3 | pass 5 |
| A01 | 0.1926 | 0.2341 | 0.2715 | 82.15 | 77.22 | 74.51 | 87.3 | 63.2 | 68.6 |
| A02 | 0.1967 | 0.2309 | 0.2541 | 76.21 | 72.43 | 68.64 | 83.6 | 77.5 | 80.2 |
| A03 | 0.1984 | 0.2537 | 0.2806 | 87.38 | 84.84 | 81.08 | 58.7 | 67.2 | 65.8 |
| A04 | 0.2008 | 0.2181 | 0.2393 | 77.52 | 73.69 | 65.63 | 126.4 | 112.8 | 87.3 |
| A05 | 0.1901 | 0.2328 | 0.2683 | 86.46 | 81.22 | 79.25 | 74.6 | 65.9 | 62.7 |
| A06 | 0.2024 | 0.2113 | 0.2260 | 79.09 | 76.56 | 73.45 | 101.4 | 94.7 | 92.6 |
| A07 | 0.1911 | 0.2270 | 0.2572 | 74.88 | 70.86 | 65.62 | 96.2 | 78.9 | 67.4 |
| A08 | 0.2060 | 0.2435 | 0.2699 | 85.23 | 82.23 | 76.04 | 86.1 | 85.2 | 60.9 |
| A09 | 0.2065 | 0.2496 | 0.2709 | 82.15 | 77.97 | 73.25 | 88.7 | 76.3 | 62.8 |
| A10 | 0.2088 | 0.2467 | 0.2695 | 82.76 | 79.79 | 75.84 | 82.6 | 75.5 | 64.8 |
| A11 | 0.2082 | 0.2431 | 0.2634 | 84.10 | 80.29 | 76.32 | 89.4 | 79.0 | 68.7 |
| A12 | 0.2060 | 0.2471 | 0.2695 | 82.67 | 78.49 | 73.31 | 81.0 | 70.1 | 64.7 |
| A13 | 0.2074 | 0.2459 | 0.2691 | 82.69 | 79.99 | 74.71 | 82.0 | 75.2 | 65.3 |

**Table A.1 :** The MFR, Lightness Index and O.I.T. values of each formula of HDPE compounded with Blended AO and OBA.

| Formular | MFR (g/10min) | | | Lightness Index | | | O.I.T. (min) | | |
|---|---|---|---|---|---|---|---|---|---|
| | pass 1 | pass 3 | pass 5 | pass 1 | pass 3 | pass 5 | pass 1 | pass 3 | pass 5 |
| B01 | 0.1906 | 0.2336 | 0.2685 | 82.87 | 78.03 | 74.24 | 72.2 | 56.3 | 54.4 |
| B02 | 0.1778 | 0.2273 | 0.2464 | 62.32 | 60.04 | 58.75 | 80.2 | 91.6 | 101.4 |
| B03 | 0.2021 | 0.2399 | 0.2725 | 80.87 | 76.08 | 73.20 | 50.0 | 48.0 | 43.3 |
| B04 | 0.1879 | 0.2332 | 0.2641 | 67.51 | 63.23 | 60.73 | 74.0 | 88.0 | 78.1 |
| B05 | 0.1936 | 0.2411 | 0.2817 | 84.78 | 80.13 | 76.71 | 71.3 | 57.1 | 60.7 |
| B06 | 0.1729 | 0.2260 | 0.2490 | 66.64 | 64.42 | 63.56 | 115.1 | 97.4 | 108.9 |
| B07 | 0.1953 | 0.2401 | 0.2846 | 84.76 | 80.77 | 77.07 | 60.8 | 50.9 | 52.7 |
| B08 | 0.1786 | 0.2295 | 0.2455 | 70.80 | 66.09 | 63.44 | 64.3 | 60.1 | 58.5 |
| B09 | 0.2111 | 0.2500 | 0.3253 | 91.48 | 86.29 | 82.85 | 49.3 | 40.1 | 34.3 |
| B10 | 0.1781 | 0.2262 | 0.2561 | 66.80 | 63.61 | 60.84 | 88.4 | 79.6 | 78.3 |
| B11 | 0.1615 | 0.2160 | 0.2377 | 71.59 | 67.89 | 66.22 | 94.1 | 109.5 | 88.8 |
| B12 | 0.1821 | 0.2321 | 0.2606 | 67.56 | 65.01 | 63.48 | 46.7 | 58.9 | 54.8 |
| B13 | 0.1814 | 0.2340 | 0.2688 | 68.07 | 66.57 | 63.78 | 65.1 | 70.0 | 71.5 |
| B14 | 0.1868 | 0.2387 | 0.2721 | 77.55 | 74.78 | 71.79 | 73.9 | 52.8 | 53.4 |
| B15 | 0.1714 | 0.2247 | 0.2416 | 76.00 | 72.82 | 66.57 | 62.5 | 57.1 | 54.8 |
| B16 | 0.1735 | 0.2244 | 0.2474 | 77.86 | 73.85 | 72.29 | 59.8 | 56.1 | 53.6 |
| B17 | 0.1653 | 0.2246 | 0.2457 | 72.99 | 69.58 | 67.41 | 52.6 | 49.8 | 47.5 |
| B18 | 0.1719 | 0.2259 | 0.2528 | 76.10 | 72.48 | 66.84 | 54.4 | 50.8 | 48.0 |
| B19 | 0.1729 | 0.2339 | 0.2492 | 77.92 | 73.61 | 72.38 | 57.1 | 56.4 | 54.3 |
| B20 | 0.1649 | 0.2258 | 0.2464 | 73.21 | 69.95 | 67.32 | 53.6 | 49.0 | 48.7 |

**Table A.2** : The MFR, Lightness Index and O.I.T. values of each formula of HDPE compounded with PATHP, DLTDP and OBA.

| Formular | MFR (g/10min) | | | Lightness Index | | | O.I.T. (min) | | |
|---|---|---|---|---|---|---|---|---|---|
| | pass 1 | pass 3 | pass 5 | pass 1 | pass 3 | pass 5 | pass 1 | pass 3 | pass 5 |
| C01 | 0.1960 | 0.2294 | 0.2932 | 82.29 | 77.76 | 74.09 | 67.3 | 61.9 | 55.1 |
| C02 | 0.1906 | 0.2467 | 0.2687 | 68.83 | 66.25 | 64.34 | 117.9 | 95.1 | 89.7 |
| C03 | 0.1959 | 0.2345 | 0.2798 | 84.40 | 82.79 | 79.67 | 41.0 | 42.6 | 36.9 |
| C04 | 0.1625 | 0.2385 | 0.2755 | 67.49 | 65.14 | 62.64 | 68.2 | 75.3 | 74.6 |
| C05 | 0.1901 | 0.2621 | 0.2958 | 82.74 | 78.92 | 71.72 | 57.8 | 65.4 | 62.7 |
| C06 | 0.1889 | 0.2513 | 0.2771 | 69.86 | 66.75 | 60.46 | 93.6 | 104.4 | 102.5 |
| C07 | 0.2046 | 0.2508 | 0.3044 | 86.55 | 78.29 | 69.20 | 75.5 | 45.5 | 51.9 |
| C08 | 0.1723 | 0.2366 | 0.2562 | 68.36 | 64.73 | 59.09 | 84.6 | 60.1 | 53.3 |
| C09 | 0.1893 | 0.2306 | 0.3045 | 85.94 | 82.48 | 79.41 | 47.8 | 44.8 | 44.2 |
| C10 | 0.1838 | 0.2451 | 0.2673 | 64.77 | 60.45 | 56.27 | 106.2 | 85.9 | 75.4 |
| C11 | 0.1819 | 0.2462 | 0.2747 | 75.96 | 72.10 | 67.53 | 97.1 | 100.4 | 107.2 |
| C12 | 0.1797 | 0.2241 | 0.2559 | 78.57 | 75.94 | 70.12 | 59.1 | 33.6 | 47.0 |
| C13 | 0.1731 | 0.2238 | 0.2667 | 74.86 | 71.57 | 69.00 | 73.9 | 52.8 | 40.9 |
| C14 | 0.1717 | 0.2331 | 0.2666 | 81.57 | 78.34 | 75.04 | 73.2 | 60.3 | 54.7 |
| C15 | 0.1712 | 0.2216 | 0.2648 | 78.40 | 75.96 | 74.18 | 57.5 | 50.5 | 48.3 |
| C16 | 0.1765 | 0.2274 | 0.2590 | 78.34 | 74.14 | 70.95 | 68.0 | 53.8 | 50.1 |
| C17 | 0.1703 | 0.2225 | 0.2585 | 79.80 | 75.83 | 73.84 | 73.3 | 56.9 | 53.7 |
| C18 | 0.1778 | 0.2283 | 0.2678 | 80.07 | 76.66 | 74.89 | 77.4 | 59.1 | 58.6 |
| C19 | 0.1705 | 0.2210 | 0.2652 | 78.24 | 74.95 | 71.52 | 68.4 | 56.7 | 55.9 |
| C20 | 0.1755 | 0.2287 | 0.2671 | 78.83 | 75.21 | 72.46 | 64.9 | 52.4 | 49.0 |

**Table A.3** : The MFR, Lightness Index and O.I.T. values of each formula of HDPE compounded with PATHP, DSTDP and OBA.

| Formular | MFR (g/10min) | | | Lightness Index | | | O.I.T. (min) | | |
|---|---|---|---|---|---|---|---|---|---|
| | pass 1 | pass 3 | pass 5 | pass 1 | pass 3 | pass 5 | pass 1 | pass 3 | pass 5 |
| D01 | 0.1805 | 0.2314 | 0.2742 | 84.33 | 79.99 | 75.10 | 62.9 | 55.6 | 51.4 |
| D02 | 0.1822 | 0.2436 | 0.2788 | 76.70 | 72.47 | 68.32 | 73.6 | 65.1 | 77.7 |
| D03 | 0.2172 | 0.2874 | 0.3194 | 85.01 | 80.94 | 77.64 | 62.0 | 47.4 | 37.4 |
| D04 | 0.2018 | 0.2804 | 0.3191 | 78.14 | 73.12 | 69.98 | 69.9 | 58.4 | 54.2 |
| D05 | 0.2081 | 0.2826 | 0.3392 | 88.09 | 85.42 | 82.32 | 60.3 | 51.1 | 68.2 |
| D06 | 0.2227 | 0.2898 | 0.3117 | 78.12 | 75.67 | 71.68 | 63.0 | 56.0 | 50.1 |
| D07 | 0.1834 | 0.2241 | 0.2790 | 85.21 | 80.39 | 77.10 | 50.0 | 42.5 | 37.3 |
| D08 | 0.1925 | 0.2427 | 0.2847 | 81.19 | 77.87 | 73.75 | 59.2 | 54.9 | 49.0 |
| D09 | 0.1889 | 0.2414 | 0.2970 | 88.30 | 84.11 | 79.98 | 49.3 | 40.1 | 34.3 |
| D10 | 0.1874 | 0.2421 | 0.2722 | 79.24 | 74.68 | 71.29 | 64.6 | 70.8 | 68.7 |
| D11 | 0.1909 | 0.2519 | 0.2925 | 86.24 | 82.00 | 78.04 | 94.1 | 81.4 | 87.4 |
| D12 | 0.1846 | 0.2455 | 0.2841 | 84.55 | 80.67 | 77.26 | 61.5 | 48.3 | 53.4 |
| D13 | 0.1876 | 0.2474 | 0.2858 | 78.96 | 73.95 | 70.19 | 66.7 | 62.1 | 51.3 |
| D14 | 0.1987 | 0.2526 | 0.2972 | 85.07 | 80.96 | 78.25 | 59.4 | 52.4 | 49.0 |
| D15 | 0.1914 | 0.2431 | 0.2758 | 83.47 | 79.52 | 77.97 | 73.0 | 67.0 | 60.6 |
| D16 | 0.1960 | 0.2405 | 0.2764 | 84.05 | 80.72 | 76.39 | 72.0 | 63.2 | 55.1 |
| D17 | 0.1939 | 0.2391 | 0.2722 | 81.79 | 77.43 | 74.76 | 77.3 | 69.6 | 61.7 |
| D18 | 0.1919 | 0.2472 | 0.2840 | 82.36 | 78.54 | 75.68 | 75.5 | 61.6 | 56.1 |
| D19 | 0.1958 | 0.2485 | 0.2749 | 82.63 | 79.03 | 75.83 | 78.5 | 67.4 | 61.9 |
| D20 | 0.1901 | 0.2356 | 0.2825 | 82.21 | 79.08 | 75.57 | 72.7 | 65.3 | 54.9 |

**Table A.4** : The MFR, Lightness Index and O.I.T. values of each formula of HDPE compounded with ODHP, DLTDP and OBA.

| Formular | MFR (g/10min) | | | Lightness Index | | | O.I.T. (min) | | |
|---|---|---|---|---|---|---|---|---|---|
| | pass 1 | pass 3 | pass 5 | pass 1 | pass 3 | pass 5 | pass 1 | pass 3 | pass 5 |
| E01 | 0.1808 | 0.2260 | 0.2895 | 87.83 | 84.04 | 79.35 | 45.3 | 50.0 | 49.4 |
| E02 | 0.1933 | 0.2573 | 0.2663 | 75.51 | 71.85 | 66.81 | 90.3 | 78.8 | 69.0 |
| E03 | 0.2023 | 0.2251 | 0.3158 | 83.55 | 77.03 | 73.20 | 34.4 | 30.4 | 32.5 |
| E04 | 0.2199 | 0.2377 | 0.2608 | 76.04 | 70.11 | 67.28 | 48.8 | 39.6 | 37.9 |
| E05 | 0.1915 | 0.2872 | 0.3393 | 86.59 | 81.20 | 76.24 | 77.6 | 63.1 | 60.2 |
| E06 | 0.1865 | 0.2401 | 0.2657 | 83.91 | 77.79 | 73.51 | 76.6 | 57.5 | 53.6 |
| E07 | 0.1908 | 0.2557 | 0.3058 | 86.00 | 80.54 | 76.53 | 58.9 | 44.6 | 39.8 |
| E08 | 0.1775 | 0.2227 | 0.2376 | 81.78 | 77.07 | 73.12 | 49.6 | 41.4 | 36.7 |
| E09 | 0.1820 | 0.2393 | 0.3121 | 84.46 | 78.56 | 69.26 | 47.8 | 44.8 | 44.2 |
| E10 | 0.2035 | 0.2601 | 0.2807 | 78.88 | 74.72 | 66.24 | 59.2 | 55.7 | 52.7 |
| E11 | 0.1813 | 0.2368 | 0.2628 | 84.38 | 78.57 | 72.75 | 75.8 | 74.6 | 69.6 |
| E12 | 0.2069 | 0.2418 | 0.2809 | 83.41 | 77.63 | 74.32 | 47.7 | 43.6 | 41.7 |
| E13 | 0.2132 | 0.2683 | 0.3078 | 81.43 | 77.20 | 74.25 | 72.8 | 52.8 | 61.0 |
| E14 | 0.2058 | 0.2897 | 0.3175 | 86.31 | 83.21 | 81.05 | 81.7 | 64.8 | 60.8 |
| E15 | 0.1982 | 0.2535 | 0.2978 | 83.75 | 80.66 | 78.25 | 66.6 | 61.6 | 65.4 |
| E16 | 0.1984 | 0.2562 | 0.2806 | 84.72 | 80.18 | 77.11 | 67.5 | 59.8 | 63.5 |
| E17 | 0.1992 | 0.2595 | 0.2926 | 83.15 | 79.50 | 76.75 | 79.0 | 65.3 | 70.2 |
| E18 | 0.1926 | 0.2459 | 0.2847 | 82.67 | 78.11 | 75.79 | 75.2 | 62.3 | 70.3 |
| E19 | 0.1949 | 0.2509 | 0.2981 | 83.45 | 78.89 | 75.93 | 70.0 | 56.9 | 61.3 |
| E20 | 0.1926 | 0.2427 | 0.2972 | 83.20 | 79.81 | 76.02 | 71.2 | 56.4 | 61.2 |

**Table A.5 :** The MFR, Lightness Index and O.I.T. values of each formula of HDPE compounded with ODHP, DSTDP and OBA.

| Formular | MFR (g/10min) | | | Lightness Index | | | O.I.T. (min) | | |
|---|---|---|---|---|---|---|---|---|---|
| | pass 1 | pass 3 | pass 5 | pass 1 | pass 3 | pass 5 | pass 1 | pass 3 | pass 5 |
| F01 | 0.1924 | 0.2169 | 0.2430 | 78.08 | 72.39 | 67.73 | 72.7 | 77.5 | 79.1 |
| F02 | 0.1884 | 0.2165 | 0.2405 | 60.22 | 53.07 | 52.02 | 114.8 | 106.8 | 103.8 |
| F03 | 0.2061 | 0.2384 | 0.2582 | 79.01 | 73.81 | 70.65 | 70.1 | 65.8 | 57.3 |
| F04 | 0.1884 | 0.2182 | 0.2451 | 65.33 | 52.73 | 46.95 | 84.4 | 76.0 | 83.2 |
| F05 | 0.2073 | 0.2423 | 0.2564 | 77.79 | 71.59 | 66.79 | 87.6 | 65.0 | 47.6 |
| F06 | 0.1877 | 0.2149 | 0.2460 | 65.69 | 57.06 | 52.35 | 104.3 | 102.3 | 87.8 |
| F07 | 0.1926 | 0.2223 | 0.2556 | 82.51 | 76.19 | 71.47 | 76.5 | 79.6 | 60.4 |
| F08 | 0.1503 | 0.1826 | 0.1970 | 55.22 | 41.63 | 35.85 | 105.4 | 89.1 | 93.8 |
| F09 | 0.1864 | 0.2195 | 0.2650 | 86.58 | 74.35 | 66.46 | 49.3 | 40.1 | 34.3 |
| F10 | 0.1641 | 0.2014 | 0.2155 | 58.05 | 49.30 | 44.82 | 102.4 | 86.3 | 78.8 |
| F11 | 0.1622 | 0.1946 | 0.2133 | 66.87 | 61.43 | 55.69 | 99.5 | 121.7 | 115.6 |
| F12 | 0.1683 | 0.1962 | 0.2011 | 71.53 | 64.25 | 59.91 | 79.8 | 76.7 | 74.7 |
| F13 | 0.1651 | 0.2070 | 0.2129 | 63.63 | 56.66 | 52.09 | 83.7 | 88.5 | 85.5 |
| F14 | 0.1682 | 0.1984 | 0.2138 | 61.52 | 55.90 | 51.01 | 96.7 | 89.3 | 78.3 |
| F15 | 0.1455 | 0.1830 | 0.1948 | 72.36 | 62.51 | 57.25 | 88.8 | 81.9 | 80.6 |
| F16 | 0.1528 | 0.1817 | 0.1949 | 68.29 | 59.15 | 53.02 | 88.3 | 75.8 | 73.3 |
| F17 | 0.1424 | 0.1795 | 0.2062 | 70.74 | 60.75 | 53.08 | 80.0 | 77.6 | 75.1 |
| F18 | 0.1415 | 0.1866 | 0.1935 | 71.81 | 62.04 | 54.89 | 83.7 | 78.2 | 74.2 |
| F19 | 0.1566 | 0.1919 | 0.2074 | 69.30 | 58.18 | 52.12 | 81.3 | 79.6 | 80.4 |
| F20 | 0.1538 | 0.1908 | 0.2084 | 72.25 | 62.72 | 56.96 | 84.2 | 73.7 | 79.2 |

**Table A.6 :** The MFR, Lightness Index and O.I.T. values of each formula of HDPE compounded with DAT, DLTDP and OBA.

| Formular | MFR (g/10min) | | | Lightness Index | | | O.I.T. (min) | | |
|---|---|---|---|---|---|---|---|---|---|
| | pass 1 | pass 3 | pass 5 | pass 1 | pass 3 | pass 5 | pass 1 | pass 3 | pass 5 |
| G01 | 0.1696 | 0.2002 | 0.2247 | 76.49 | 68.26 | 63.36 | 72.9 | 79.0 | 75.3 |
| G02 | 0.1589 | 0.1957 | 0.2109 | 62.57 | 54.53 | 48.56 | 100.5 | 97.5 | 89.3 |
| G03 | 0.1698 | 0.2028 | 0.2256 | 80.83 | 73.55 | 68.26 | 68.5 | 61.3 | 50.2 |
| G04 | 0.1601 | 0.1963 | 0.2122 | 64.51 | 56.16 | 52.03 | 87.5 | 83.1 | 82.6 |
| G05 | 0.1658 | 0.2010 | 0.2241 | 78.43 | 79.65 | 64.55 | 94.1 | 71.6 | 69.6 |
| G06 | 0.1559 | 0.1911 | 0.2106 | 64.72 | 53.99 | 45.98 | 107.2 | 98.8 | 95.0 |
| G07 | 0.1879 | 0.2063 | 0.2162 | 78.44 | 72.09 | 67.78 | 70.0 | 67.5 | 64.0 |
| G08 | 0.1629 | 0.1903 | 0.1974 | 66.76 | 58.00 | 53.21 | 92.6 | 83.2 | 73.5 |
| G09 | 0.1819 | 0.2038 | 0.2583 | 90.75 | 87.32 | 84.86 | 47.8 | 44.8 | 44.2 |
| G10 | 0.1655 | 0.1926 | 0.2143 | 56.04 | 45.58 | 37.36 | 87.5 | 108.9 | 100.8 |
| G11 | 0.1635 | 0.1974 | 0.2068 | 70.14 | 62.91 | 59.21 | 117.0 | 102.9 | 98.8 |
| G12 | 0.1647 | 0.1955 | 0.2048 | 70.90 | 63.39 | 58.70 | 103.7 | 94.2 | 72.5 |
| G13 | 0.1737 | 0.1980 | 0.2181 | 63.75 | 56.27 | 50.39 | 100.4 | 82.0 | 72.2 |
| G14 | 0.1738 | 0.1936 | 0.2138 | 70.34 | 63.71 | 57.82 | 101.7 | 90.3 | 77.9 |
| G15 | 0.1713 | 0.1967 | 0.2181 | 69.10 | 60.74 | 55.92 | 91.0 | 83.9 | 80.0 |
| G16 | 0.1697 | 0.1949 | 0.2125 | 69.42 | 63.87 | 60.21 | 94.8 | 90.7 | 76.1 |
| G17 | 0.1655 | 0.1941 | 0.2174 | 66.41 | 60.47 | 56.28 | 98.3 | 92.2 | 77.9 |
| G18 | 0.1683 | 0.1948 | 0.2119 | 71.87 | 64.47 | 60.46 | 90.9 | 83.1 | 85.3 |
| G19 | 0.1677 | 0.1961 | 0.2100 | 69.54 | 64.31 | 60.16 | 92.7 | 85.3 | 79.0 |
| G20 | 0.1665 | 0.1962 | 0.2167 | 66.23 | 60.85 | 56.27 | 92.9 | 84.2 | 81.2 |

**Table A.7** : The MFR, Lightness Index and O.I.T. values of each formula of HDPE compounded with DAT, DSTDP and OBA.

# APPENDIX B

## ANOVA TABLE AND REGRESSION COEFFICIENTS

Table B.1 : ANOVA table for the multiple regression analysis of the interactions of Blended antioxidant and OBA on the Lightness index after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 165.0611 | 5 | 33.0122 | 15.33 |
| - First order terms | 142.0129 | 2 | 71.0064 | 32.97 |
| - Second order terms | 23.0483 | 3 | 7.6828 | 3.57 |
| Error | 15.0775 | 7 | 2.1539 | |
| - Lack of fit | 12.5297 | 3 | 4.1766 | 6.56 |
| - Pure error | 2.5477 | 4 | 0.5369 | |
| Total | 180.1386 | 12 | $R^2 = 0.9277$ | |

Table B.2 : Statistic-$t_0$ of coefficients testing for interactions of Blended antioxidant and OBA on the Lightness index after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,7} = 2.365$) |
|---|---|---|---|
| $b_0$ | 82.07400 | 125.05 | Significance |
| $b_1$ | -3.27785 | 4.18 | Significance |
| $b_2$ | 2.64714 | 5.36 | Significance |
| $b_{11}$ | -0.29950 | -7.13 | Significance |
| $b_{22}$ | -1.65950 | -5.69 | Significance |
| $b_{12}$ | -0.98000 | -0.64 | Not Significance |

Table B.3 : ANOVA table for the multiple regression analysis of the interactions of Blended antioxidant and OBA on the Lightness index after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 168.3346 | 5 | 33.6669 | 10.51 |
| - First order terms | 141.3242 | 2 | 70.6621 | 22.05 |
| - Second order terms | 27.0104 | 3 | 9.0035 | 2.81 |
| Error | 22.4322 | 7 | 3.2046 | |
| - Lack of fit | 18.3111 | 3 | 6.1037 | 5.92 |
| - Pure error | 4.1211 | 4 | 1.0303 | |
| Total | 190.7668 | 12 | $R^2 = 0.8824$ | |

Table B.4 : Statistic-$t_0$ of coefficients testing for interactions of Blended antioxidant and OBA on the Lightness index after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,7} = 2.365$) |
|---|---|---|---|
| $b_0$ | 79.30600 | 99.06 | Significance |
| $b_1$ | -2.81628 | -4.45 | Significance |
| $b_2$ | 3.11995 | 4.93 | Significance |
| $b_{11}$ | -0.37613 | -0.55 | Not Significance |
| $b_{22}$ | -1.54863 | -2.28 | Not Significance |
| $b_{12}$ | -1.59000 | -1.78 | Not Significance |

Table B.5 : ANOVA table for the multiple regression analysis of the interactions of Blended anticxidant and OBA on the Lightness index after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 212.6682 | 5 | 42.5336 | 6.25 |
| - First order terms | 150.7902 | 2 | 75.3951 | 11.08 |
| - Second order terms | 61.8780 | 3 | 20.6260 | 3.03 |
| Error | 47.6109 | 7 | 6.8016 | |
| - Lack of fit | 39.6532 | 3 | 13.2177 | 6.64 |
| - Pure error | 7.9577 | 4 | 1.9894 | |
| Total | 260.2791 | 12 | $R^2 = 0.8171$ | |

Table B.6 : Statistic-$t_0$ of coefficients testing for interactions of Blended antioxidant and OBA on the Lightness index after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,7} = 2.365$) |
|---|---|---|---|
| $b_0$ | 74.68600 | 64.04 | Significance |
| $b_1$ | -3.69031 | -4.60 | Significance |
| $b_2$ | 2.28702 | 2.48 | Significance |
| $b_{11}$ | 0.55075 | 0.56 | Not Significance |
| $b_{22}$ | -2.20925 | -2.23 | Not Significance |
| $b_{12}$ | -2.39500 | -1.84 | Not Significance |

Table B.7 : ANOVA table for the multiple regression analysis of the interactions of Blended antioxidant and OBA on the Melt Flow Rate after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.00053514 | 5 | 0.000107028 | 24.09 |
| - First order terms | 0.00020530 | 2 | 0.000102650 | 23.10 |
| - Second order terms | 0.00032984 | 3 | 0.000109947 | 24.75 |
| Error | 0.00003110 | 7 | 0.000004443 | |
| - Lack of fit | 0.00002570 | 3 | 0.000008567 | 6.35 |
| - Pure error | 0.00000540 | 4 | 0.000001350 | |
| Total | 0.00056624 | 12 | $R^2 = 0.9451$ | |

Table B.8 : Statistic-$t_0$ of coefficients testing for interactions of Blended antioxidant and OBA on the Melt Flow Rate after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,7} = 2.365$) |
|---|---|---|---|
| $b_0$ | 0.20738 | 220.00 | Significance |
| $b_1$ | 0.00311 | 4.18 | Significance |
| $b_2$ | 0.00400 | 5.36 | Significance |
| $b_{11}$ | -0.00570 | -7.13 | Significance |
| $b_{22}$ | -0.00455 | -5.69 | Significance |
| $b_{12}$ | -0.00068 | -0.64 | Not Significance |

Table B.9 : ANOVA table for the multiple regression analysis of the interactions of Blended anticxidant and OBA on the Melt Flow Rate after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.00184628 | 5 | 0.000369256 | 20.43 |
| - First order terms | 0.00071220 | 2 | 0.000356100 | 19.71 |
| - Second order terms | 0.00113408 | 3 | 0.000378027 | 20.92 |
| Error | 0.00012650 | 7 | 0.000018071 | |
| - Lack of fit | 0.00010460 | 3 | 0.000034867 | 6.37 |
| - Pure error | 0.00002190 | 4 | 0.000005475 | |
| Total | 0.00197278 | 12 | $R^2 = 0.9359$ | |

Table B.10 : Statistic-$t_0$ of coefficients testing for interactions of Blended antioxidant and OBA on the Melt Flow Rate after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,7} = 2.365$) |
|---|---|---|---|
| $b_0$ | 0.24648 | 129.65 | Significance |
| $b_1$ | -0.00865 | -5.76 | Significance |
| $b_2$ | 0.00377 | 2.51 | Significance |
| $b_{11}$ | -0.01083 | -6.72 | Significance |
| $b_{22}$ | -0.00423 | -2.62 | Significance |
| $b_{12}$ | -0.00810 | -3.81 | Significance |

Table B.11 : ANOVA table for the multiple regression analysis of the interactions of Blended antioxidant and OBA on the Melt Flow Rate after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.00250149 | 5 | 0.000500298 | 19.81 |
| - First order terms | 0.00177470 | 2 | 0.000887350 | 35.13 |
| - Second order terms | 0.00072679 | 3 | 0.000242263 | 9.59 |
| Error | 0.00017680 | 7 | 0.000025257 | |
| - Lack of fit | 0.00014270 | 3 | 0.000047567 | 5.58 |
| - Pure error | 0.00003410 | 4 | 0.000008525 | |
| Total | 0.00267829 | 12 | $R^2 = 0.9340$ | |

Table B.12 : Statistic-$t_0$ of coefficients testing for interactions of Blended antioxidant and OBA on the Melt Flow Rate after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,7} = 2.365$) |
|---|---|---|---|
| $b_0$ | 0.26848 | 119.46 | Significance |
| $B_1$ | -0.01482 | -8.34 | Significance |
| $b_2$ | 0.00153 | 0.86 | Not Significance |
| $b_{11}$ | -0.00916 | -4.81 | Significance |
| $b_{22}$ | -0.00096 | -0.5 | Not Significance |
| $b_{12}$ | -0.00598 | -2.38 | Significance |

Table B.13 : ANOVA table for the multiple regression analysis of the interactions of Blended anticxidant and OBA on the Oxidative Induction Time after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 2646.01817 | 5 | 529.2036 | 14.78 |
| - First order terms | 1297.97570 | 2 | 648.9879 | 18.72 |
| - Second order terms | 1348.04247 | 3 | 449.3475 | 12.55 |
| Error | 250.69260 | 7 | 35.8132 | |
| - Lack of fit | 187.22060 | 3 | 62.4069 | 3.93 |
| - Pure error | 63.47200 | 4 | 15.8680 | |
| Total | 2896.7108 | 12 | $R^2$ = 0.9135 | |

Table B.14 : Statistic-$t_0$ of coefficients testing for interactions of Blended antioxidant and OBA on the Oxidative Induction Time after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,7}$ = 2.365) |
|---|---|---|---|
| $b_0$ | 84.74000 | 31.66 | Significance |
| $b_1$ | 12.73760 | 6.02 | Significance |
| $b_2$ | -0.01044 | 0.00 | Not Significance |
| $b_{11}$ | 1.48625 | 0.66 | Not Significance |
| $b_{22}$ | 3.06125 | 1.35 | Not Significance |
| $b_{12}$ | 17.85000 | 5.97 | Significance |

Table B.15 : ANOVA table for the multiple regression analysis of the interactions of Blended antioxidant and OBA on the Oxidative Induction Time after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 1895.8484 | 5 | 379.1697 | 12.94 |
| - First order terms | 1556.3033 | 2 | 778.1517 | 26.55 |
| - Second order terms | 339.5451 | 3 | 113.1817 | 3.86 |
| Error | 205.1347 | 7 | 29.3050 | |
| - Lack of fit | 163.3867 | 3 | 54.4622 | 5.22 |
| - Pure error | 41.7480 | 4 | 10.4370 | |
| Total | 2100.9831 | 12 | $R^2 = 0.9024$ | |

Table B.16 : Statistic-$t_0$ of coefficients testing for interactions of Blended antioxidant and OBA on the Oxidative Induction Time after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,7} = 2.365$) |
|---|---|---|---|
| $b_0$ | 75.22000 | 31.07 | Significance |
| $b_1$ | 12.57865 | 6.57 | Significance |
| $b_2$ | 6.02620 | 3.15 | Significance |
| $b_{11}$ | 2.29000 | 1.12 | Not Significance |
| $b_{22}$ | 3.16500 | 1.54 | Not Significance |
| $b_{12}$ | 7.82500 | 2.89 | Significance |

Table B.17 : ANOVA table for the multiple regression analysis of the interactions of Blended antioxidant and OBA on the Oxidative Induction Time after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 1113.4735 | 5 | 222.6947 | 16.66 |
| - First order terms | 713.3539 | 2 | 356.6770 | 26.68 |
| - Second order terms | 400.1195 | 3 | 133.3732 | 9.98 |
| Error | 93.5773 | 7 | 13.3682 | |
| - Lack of fit | 75.1623 | 3 | 25.0541 | 5.44 |
| - Pure error | 18.4150 | 4 | 4.6038 | |
| Total | 1207.0508 | 12 | $R^2 = 0.9225$ | |

Table B.18 : Statistic-$t_0$ of coefficients testing for interactions of Blended antioxidant and OBA on the Oxidative Induction Time after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,7} = 2.365$) |
|---|---|---|---|
| $b_0$ | 65.2600 | 39.91 | Significance |
| $b_1$ | 9.4231 | 7.29 | Significance |
| $b_2$ | -0.6116 | -0.47 | Not Significance |
| $b_{11}$ | 7.3388 | 5.29 | Significance |
| $b_{22}$ | 0.5888 | 0.42 | Not Significance |
| $b_{12}$ | 2.4750 | 1.35 | Not Significance |

Table B.19 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DLTDP and OBA on the Lightness index after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 1025.7971 | 9 | 113.9775 | 21.86 |
| - First order terms | 909.5621 | 3 | 303.1874 | 58.14 |
| - Second order terms | 116.2350 | 6 | 19.3725 | 3.72 |
| Error | 52.1454 | 10 | 5.2145 | |
| - Lack of fit | 28.7596 | 5 | 5.7519 | 1.23 |
| - Pure error | 23.3858 | 5 | 4.6772 | |
| Total | 1077.9425 | 19 | $R^2 = 0.9516$ | |

Table B.20 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DLTDP and OBA on the Lightness index after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 75.6368 | 81.22 | Significance |
| $b_1$ | -7.8727 | -12.74 | Significance |
| $b_2$ | 0.0404 | 0.07 | Not Significance |
| $b_3$ | 2.1494 | 3.48 | Significance |
| $b_{11}$ | 1.5058 | 2.50 | Significance |
| $b_{22}$ | -1.8760 | -3.12 | Significance |
| $b_{33}$ | -0.7322 | -1.22 | Not Significance |
| $b_{12}$ | 1.4213 | 1.76 | Not Significance |
| $b_{13}$ | 0.2263 | 0.28 | Not Significance |
| $b_{23}$ | 0.1188 | 0.15 | Not Significance |

Table B.21 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DLTDP and OBA on the Lightness index after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 862.233605 | 9 | 95.80373 | 32.200 |
| - First order terms | 788.9458 | 3 | 262.98193 | 88.389 |
| - Second order terms | 73.287805 | 6 | 12.21463 | 4.105 |
| Error | 29.75285 | 10 | 2.97529 | |
| - Lack of fit | 12.79057 | 5 | 2.55811 | 0.754 |
| - Pure error | 16.96228 | 5 | 3.39246 | |
| Total | 891.986455 | 19 | $R^2 = 0.9666$ | |

Table B.22 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DLTDP and OBA on the Lightness index after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 72.033 | 102.40 | Significance |
| $b_1$ | -7.276 | -15.59 | Significance |
| $b_2$ | -0.095 | -0.20 | Not Significance |
| $b_3$ | 2.038 | 4.37 | Significance |
| $b_{11}$ | 1.129 | 2.49 | Significance |
| $b_{22}$ | -1.876 | -4.13 | Significance |
| $b_{33}$ | -0.382 | -0.84 | Not Significance |
| $b_{12}$ | 0.771 | 1.26 | Not Significance |
| $b_{13}$ | 0.056 | 0.09 | Not Significance |
| $b_{23}$ | 0.134 | 0.22 | Not Significance |

Table B.23 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DLTDP and OBA on the Lightness index after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 723.298 | 9 | 80.366 | 18.02 |
| - First order terms | 672.040 | 3 | 224.013 | 50.23 |
| - Second order terms | 51.258 | 6 | 8.543 | 1.92 |
| Error | 44.596 | 10 | 4.460 | |
| - Lack of fit | 6.662 | 5 | 1.332 | 0.18 |
| - Pure error | 37.933 | 5 | 7.587 | |
| Total | 767.894 | 19 | $R^2 = 0.9419$ | |

Table B.24 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DLTDP and OBA on the Lightness index after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 68.791 | 79.88 | Significance |
| $b_1$ | -6.719 | -11.76 | Significance |
| $b_2$ | -0.251 | -0.44 | Not Significance |
| $b_3$ | 2.001 | 3.50 | Significance |
| $b_{11}$ | 1.148 | 2.06 | Not Significance |
| $b_{22}$ | -1.325 | -2.38 | Significance |
| $b_{33}$ | -0.287 | -0.52 | Not Significance |
| $b_{12}$ | 0.318 | 0.43 | Not Significance |
| $b_{13}$ | 0.148 | 0.20 | Not Significance |
| $b_{23}$ | -0.088 | -0.12 | Not Significance |

Table B.25 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DLTDP and OBA on the Melt Flow Rate after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.002975 | 9 | 0.000331 | 17.63 |
| - First order terms | 0.001355 | 3 | 0.000452 | 24.09 |
| - Second order terms | 0.001620 | 6 | 0.000270 | 14.40 |
| Error | 0.000188 | 10 | 0.000019 | |
| - Lack of fit | 0.000113 | 5 | 0.000023 | 1.52 |
| - Pure error | 0.000074 | 5 | 0.000015 | |
| Total | 0.003162 | 19 | $R^2 = 0.9407$ | |

Table B.26 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DLTDP and OBA on the Melt Flow Rate after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.16989 | 96.21 | Significance |
| $b_1$ | -0.00878 | -7.49 | Significance |
| $b_2$ | 0.00466 | 3.98 | Significance |
| $b_3$ | -0.00065 | -0.56 | Not Significance |
| $b_{11}$ | 0.00934 | 8.19 | Significance |
| $b_{22}$ | 0.00128 | 1.12 | Not Significance |
| $b_{33}$ | 0.00563 | 4.94 | Significance |
| $b_{12}$ | 0.00033 | 0.21 | Not Significance |
| $b_{13}$ | -0.00130 | -0.85 | Not Significance |
| $b_{23}$ | -0.00178 | -1.16 | Not Significance |

Table B.27 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DLTDP and OBA on the Melt Flow Rate after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.001058 | 9 | 0.000118 | 9.77 |
| - First order terms | 0.000590 | 3 | 0.000197 | 16.34 |
| - Second order terms | 0.000468 | 6 | 0.000078 | 6.49 |
| Error | 0.000120 | 10 | 0.000012 | |
| - Lack of fit | 0.000053 | 5 | 0.000011 | 0.80 |
| - Pure error | 0.000067 | 5 | 0.000013 | |
| Total | 0.001178 | 19 | $R^2 = 0.9407$ | |

Table B.28 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DLTDP and OBA on the Melt Flow Rate after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.22653 | 160.16 | Significance |
| $b_1$ | -0.00576 | -6.14 | Significance |
| $b_2$ | 0.00306 | 3.26 | Significance |
| $b_3$ | 0.00078 | 0.83 | Not Significance |
| $b_{11}$ | 0.00422 | 4.61 | Significance |
| $b_{22}$ | -0.00075 | -0.82 | Not Significance |
| $b_{33}$ | 0.00360 | 3.94 | Significance |
| $b_{12}$ | 0.00051 | 0.42 | Not Significance |
| $b_{13}$ | -0.00159 | -1.29 | Not Significance |
| $b_{23}$ | -0.00121 | -0.99 | Not Significance |

Table B.29 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DLTDP and OBA on the Melt Flow Rate after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.007325 | 9 | 0.000814 | 14.64 |
| - First order terms | 0.003778 | 3 | 0.001259 | 22.65 |
| - Second order terms | 0.003547 | 6 | 0.000591 | 10.63 |
| Error | 0.000556 | 10 | 0.000056 | |
| - Lack of fit | 0.000487 | 5 | 0.000097 | 6.9 |
| - Pure error | 0.000070 | 5 | 0.000014 | |
| Total | 0.007881 | 19 | $R^2 = 0.9294$ | |

Table B.30 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DLTDP and OBA on the Melt Flow Rate after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.24742 | 81.36 | Significance |
| $b_1$ | -0.01601 | -7.93 | Significance |
| $b_2$ | 0.00437 | 2.16 | Not Significance |
| $b_3$ | 0.00109 | 0.54 | Not Significance |
| $b_{11}$ | 0.01381 | 7.03 | Significance |
| $b_{22}$ | -0.00088 | -0.45 | Not Significance |
| $b_{33}$ | 0.00665 | 3.39 | Significance |
| $b_{12}$ | 0.00091 | 0.35 | Not Significance |
| $b_{13}$ | -0.00516 | -1.96 | Not Significance |
| $b_{23}$ | -0.00279 | -1.06 | Not Significance |

Table B.31 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DLTDP and OBA on the Oxidative Induction Time after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 5050.390 | 9 | 561.154 | 10.20 |
| - First order terms | 3824.743 | 3 | 1274.914 | 23.18 |
| - Second order terms | 1225.647 | 6 | 204.274 | 3.71 |
| Error | 550.012 | 10 | 55.001 | |
| - Lack of fit | 474.899 | 5 | 94.980 | 6.32 |
| - Pure error | 75.113 | 5 | 15.023 | |
| Total | 5600.402 | 19 | $R^2 = 0.9018$ | |

Table B.32 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DLTDP and OBA on the Oxidative Induction Time after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 56.566 | 18.70 | Significance |
| $b_1$ | 10.622 | 5.29 | Significance |
| $b_2$ | -12.405 | -6.18 | Significance |
| $b_3$ | 3.654 | 1.82 | Not Significance |
| $b_{11}$ | 4.966 | 2.54 | Significance |
| $b_{22}$ | 5.514 | 2.82 | Significance |
| $b_{33}$ | 5.196 | 2.66 | Significance |
| $b_{12}$ | -3.038 | -1.16 | Not Significance |
| $b_{13}$ | 1.913 | 0.73 | Not Significance |
| $b_{23}$ | -4.113 | -1.57 | Not Significance |

Table B.33 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DLTDP and OBA on the Oxidative Induction Time after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 6319.282 | 9 | 702.142 | 13.38 |
| - First order terms | 4287.147 | 3 | 1429.049 | 27.24 |
| - Second order terms | 2032.135 | 6 | 338.689 | 6.46 |
| Error | 524.675 | 10 | 52.468 | |
| - Lack of fit | 455.855 | 5 | 91.171 | 6.62 |
| - Pure error | 68.820 | 5 | 13.764 | |
| Total | 6843.958 | 19 | $R^2 = 0.9233$ | |

Table B.34 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DLTDP and OBA on the Oxidative Induction Time after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 53.224 | 18.02 | Significance |
| $b_1$ | 14.003 | 7.14 | Significance |
| $b_2$ | -10.288 | -5.25 | Significance |
| $b_3$ | -3.465 | -1.77 | Not Significance |
| $b_{11}$ | 2.196 | 1.15 | Significance |
| $b_{22}$ | 10.805 | 5.66 | Significance |
| $b_{33}$ | 2.744 | 1.44 | Significance |
| $b_{12}$ | -3.300 | -1.29 | Not Significance |
| $b_{13}$ | -3.225 | -1.26 | Not Significance |
| $b_{23}$ | -3.950 | -1.54 | Not Significance |

Table B.35 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DLTDP and OBA on the Oxidative Induction Time after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 6810.552 | 9 | 756.728 | 17.25 |
| - First order terms | 4922.822 | 3 | 1640.941 | 37.40 |
| - Second order terms | 1887.730 | 6 | 314.622 | 7.17 |
| Error | 438.808 | 10 | 43.881 | |
| - Lack of fit | 380.313 | 5 | 76.063 | 6.50 |
| - Pure error | 58.495 | 5 | 11.699 | |
| Total | 7249.360 | 19 | $R^2 = 0.9395$ | |

Table B.36 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DLTDP and OBA on the Oxidative Induction Time after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 50.973 | 18.87 | Significance |
| $b_1$ | 15.362 | 8.57 | Significance |
| $b_2$ | -10.982 | -6.13 | Significance |
| $b_3$ | -1.965 | -1.10 | Not Significance |
| $b_{11}$ | 2.978 | 1.71 | Not Significance |
| $b_{22}$ | 8.458 | 4.85 | Significance |
| $b_{33}$ | 5.152 | 2.95 | Significance |
| $b_{12}$ | -6.825 | -2.91 | Significance |
| $b_{13}$ | -3.475 | -1.48 | Not Significance |
| $b_{23}$ | -3.000 | -1.28 | Not Significance |

Table B.37 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DSTDP and OBA on the Lightness index after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 754.303 | 9 | 83.811 | 46.30 |
| - First order terms | 711.907 | 3 | 237.302 | 131.10 |
| - Second order terms | 42.397 | 6 | 7.066 | 3.90 |
| Error | 18.101 | 10 | 1.810 | |
| - Lack of fit | 14.931 | 5 | 2.986 | 4.71 |
| - Pure error | 3.170 | 5 | 0.634 | |
| Total | 772.404 | 19 | $R^2 = 0.9766$ | |

Table B.38 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DSTDP and OBA on the Lightness index after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 78.963 | 143.92 | Significance |
| $b_1$ | -7.106 | -19.52 | Significance |
| $b_2$ | 0.547 | 1.50 | Not Significance |
| $b_3$ | 1.156 | 3.17 | Significance |
| $b_{11}$ | -1.377 | -3.89 | Significance |
| $b_{22}$ | -0.702 | -1.98 | Not Significance |
| $b_{33}$ | -0.366 | -1.03 | Not Significance |
| $b_{12}$ | -1.095 | -2.30 | Significance |
| $b_{13}$ | -0.088 | -0.18 | Not Significance |
| $b_{23}$ | 0.193 | 0.40 | Not Significance |

Table B.39 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DSTDP and OBA on the Lightness index after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 682.127 | 9 | 75.792 | 24.00 |
| - First order terms | 628.172 | 3 | 209.391 | 66.32 |
| - Second order terms | 53.955 | 6 | 8.992 | 2.85 |
| Error | 31.575 | 10 | 3.157 | |
| - Lack of fit | 27.683 | 5 | 5.537 | 7.11 |
| - Pure error | 3.892 | 5 | 0.778 | |
| Total | 713.702 | 19 | $R^2 = 0.9558$ | |

Table B.40 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DSTDP and OBA on the Lightness index after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 75.484 | 104.17 | Significance |
| $b_1$ | -6.732 | -14.00 | Significance |
| $b_2$ | 0.566 | 1.18 | Not Significance |
| $b_3$ | 0.596 | 1.24 | Not Significance |
| $b_{11}$ | -1.577 | -3.37 | Significance |
| $b_{22}$ | -0.673 | -1.44 | Not Significance |
| $b_{33}$ | -0.343 | -0.73 | Not Significance |
| $b_{12}$ | -0.941 | -1.50 | Not Significance |
| $b_{13}$ | 0.429 | 0.68 | Not Significance |
| $b_{23}$ | -0.821 | -1.31 | Not Significance |

Table B.41 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DSTDP and OBA on the Lightness index after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 687.372 | 9 | 76.375 | 7.87 |
| - First order terms | 563.947 | 3 | 187.982 | 19.37 |
| - Second order terms | 123.424 | 6 | 20.571 | 2.12 |
| Error | 97.040 | 10 | 9.704 | |
| - Lack of fit | 84.690 | 5 | 16.938 | 6.86 |
| - Pure error | 12.350 | 5 | 2.470 | |
| Total | 784.412 | 19 | $R^2 = 0.8763$ | |

Table B.42 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DSTDP and OBA on the Lightness index after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 73.028 | 57.49 | Significance |
| $b_1$ | -6.375 | -7.56 | Significance |
| $b_2$ | 0.318 | 0.38 | Not Significance |
| $b_3$ | -0.740 | -0.88 | Not Significance |
| $b_{11}$ | -2.174 | -2.65 | Significance |
| $b_{22}$ | -1.826 | -2.23 | Significance |
| $b_{33}$ | -0.697 | -0.85 | Not Significance |
| $b_{12}$ | -0.766 | -0.70 | Not Significance |
| $b_{13}$ | 0.676 | 0.61 | Not Significance |
| $b_{23}$ | -0.971 | -0.88 | Not Significance |

Table B.43 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DSTDP and OBA on the Melt Flow Rate after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.001816 | 9 | 0.000202 | 4.46 |
| - First order terms | 0.000577 | 3 | 0.000192 | 4.25 |
| - Second order terms | 0.001239 | 6 | 0.000207 | 4.56 |
| Error | 0.000453 | 10 | 0.000045 | |
| - Lack of fit | 0.000397 | 5 | 0.000079 | 7.10 |
| - Pure error | 0.000056 | 5 | 0.000011 | |
| Total | 0.002269 | 19 | $R^2 = 0.8005$ | |

Table B.44 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DSTDP and OBA on the Melt Flow Rate after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.17340 | 63.20 | Significance |
| $b_1$ | -0.00597 | -3.28 | Significance |
| $b_2$ | -0.00249 | -1.37 | Not Significance |
| $b_3$ | 0.00063 | 0.34 | Not Significance |
| $b_{11}$ | 0.00611 | 3.45 | Significance |
| $b_{22}$ | 0.00408 | 2.30 | Significance |
| $b_{33}$ | 0.00111 | 0.62 | Not Significance |
| $b_{12}$ | -0.00739 | -3.11 | Significance |
| $b_{13}$ | 0.00066 | 0.28 | Not Significance |
| $b_{23}$ | 0.00326 | 1.37 | Not Significance |

Table B.45 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DSTDP and OBA on the Melt Flow Rate after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.002095 | 9 | 0.000233 | 4.59 |
| - First order terms | 0.000685 | 3 | 0.000228 | 4.51 |
| - Second order terms | 0.001410 | 6 | 0.000235 | 4.64 |
| Error | 0.000507 | 10 | 0.000051 | |
| - Lack of fit | 0.000443 | 5 | 0.000089 | 6.90 |
| - Pure error | 0.000064 | 5 | 0.000013 | |
| Total | 0.002602 | 19 | $R^2 = 0.8052$ | |

Table B.46 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DSTDP and OBA on the Melt Flow Rate after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.22461 | 77.38 | Significance |
| $b_1$ | 0.00151 | 0.79 | Not Significance |
| $b_2$ | -0.00485 | -2.52 | Significance |
| $b_3$ | 0.00493 | 2.56 | Significance |
| $b_{11}$ | 0.00655 | 3.49 | Significance |
| $b_{22}$ | 0.00560 | 2.99 | Significance |
| $b_{33}$ | 0.00323 | 1.72 | Not Significance |
| $b_{12}$ | -0.00209 | -0.83 | Not Significance |
| $b_{13}$ | -0.00579 | -2.30 | Significance |
| $b_{23}$ | -0.00286 | -1.14 | Not Significance |

Table B.47 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DSTDP and OBA on the Melt Flow Rate after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.003622 | 9 | 0.000402 | 6.15 |
| - First order terms | 0.002040 | 3 | 0.000680 | 10.38 |
| - Second order terms | 0.001582 | 6 | 0.000264 | 4.03 |
| Error | 0.000655 | 10 | 0.000065 | |
| - Lack of fit | 0.000574 | 5 | 0.000115 | 7.09 |
| - Pure error | 0.000081 | 5 | 0.000016 | |
| Total | 0.004277 | 19 | $R^2 = 0.8469$ | |

Table B.48 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DSTDP and OBA on the Melt Flow Rate after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.26347 | 79.84 | Significance |
| $b_1$ | -0.01159 | -5.29 | Significance |
| $b_2$ | -0.00370 | -1.69 | Not Significance |
| $b_3$ | 0.00118 | 0.54 | Not Significance |
| $b_{11}$ | 0.00956 | 4.49 | Significance |
| $b_{22}$ | 0.00228 | 1.07 | Not Significance |
| $b_{33}$ | 0.00276 | 1.29 | Not Significance |
| $b_{12}$ | -0.00116 | -0.41 | Not Significance |
| $b_{13}$ | -0.00476 | -1.66 | Not Significance |
| $b_{23}$ | -0.00071 | -0.25 | Not Significance |

Table B.49 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DSTDP and OBA on the Oxidative Induction Time after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 6467.492 | 9 | 718.610 | 23.97 |
| - First order terms | 4852.750 | 3 | 1617.583 | 53.95 |
| - Second order terms | 1614.742 | 6 | 269.124 | 8.98 |
| Error | 299.814 | 10 | 29.981 | |
| - Lack of fit | 63.719 | 5 | 12.744 | 0.27 |
| - Pure error | 236.095 | 5 | 47.219 | |
| Total | 6767.306 | 19 | $R^2$ = 0.9557 | |

Table B.50 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DSTDP and OBA on the Oxidative Induction Time after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10}$ = 2.228) |
|---|---|---|---|
| $b_0$ | 68.281 | 30.58 | Significance |
| $b_1$ | 16.176 | 10.92 | Significance |
| $b_2$ | -9.608 | -6.48 | Significance |
| $b_3$ | 1.166 | 0.79 | Not Significance |
| $b_{11}$ | 2.890 | 2.00 | Not Significance |
| $b_{22}$ | 3.279 | 2.27 | Significance |
| $b_{33}$ | 1.671 | 1.16 | Not Significance |
| $b_{12}$ | -6.263 | -3.23 | Significance |
| $b_{13}$ | -4.113 | -2.12 | Not Significance |
| $b_{23}$ | 10.588 | 5.47 | Significance |

Table B.51 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DSTDP and OBA on the Oxidative Induction Time after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 6894.729 | 9 | 766.081 | 18.51 |
| - First order terms | 6022.788 | 3 | 2007.596 | 48.51 |
| - Second order terms | 871.941 | 6 | 145.323 | 3.51 |
| Error | 413.869 | 10 | 41.387 | |
| - Lack of fit | 362.169 | 5 | 72.434 | 7.01 |
| - Pure error | 51.700 | 5 | 10.340 | |
| Total | 7308.598 | 19 | $R^2 = 0.9434$ | |

Table B.52 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DSTDP and OBA on the Oxidative Induction Time after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 54.728 | 20.86 | Significance |
| $b_1$ | 13.812 | 7.93 | Significance |
| $b_2$ | -15.790 | -9.87 | Significance |
| $b_3$ | 0.960 | 0.55 | Not Significance |
| $b_{11}$ | 4.820 | 2.84 | Significance |
| $b_{22}$ | 5.403 | 3.19 | Significance |
| $b_{33}$ | 1.708 | 1.01 | Not Significance |
| $b_{12}$ | -3.113 | -1.37 | Not Significance |
| $b_{13}$ | -1.538 | -0.68 | Not Significance |
| $b_{23}$ | -3.138 | -1.38 | Not Significance |

Table B.53 : ANOVA table for the multiple regression analysis of the interactions of PATHP, DSTDP and OBA on the Oxidative Induction Time after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 6688.609 | 9 | 743.179 | 12.98 |
| - First order terms | 4890.289 | 3 | 1630.096 | 28.48 |
| - Second order terms | 1798.320 | 6 | 299.720 | 5.24 |
| Error | 572.356 | 10 | 57.236 | |
| - Lack of fit | 486.556 | 5 | 97.311 | 5.67 |
| - Pure error | 85.800 | 5 | 17.160 | |
| Total | 7260.966 | 19 | $R^2 = 0.9212$ | |

Table B.54 : Statistic-$t_0$ of coefficients testing for interactions of PATHP, DSTDP and OBA on the Oxidative Induction Time after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 52.480 | 17.01 | Significance |
| $b_1$ | 12.153 | 5.94 | Significance |
| $b_2$ | -14.245 | -6.96 | Significance |
| $b_3$ | 2.732 | 1.33 | Not Significance |
| $b_{11}$ | 3.332 | 1.67 | Not Significance |
| $b_{22}$ | 9.449 | 4.74 | Significance |
| $b_{33}$ | -0.911 | -0.46 | Not Significance |
| $b_{12}$ | -4.413 | -1.65 | Not Significance |
| $b_{13}$ | -3.888 | -1.45 | Not Significance |
| $b_{23}$ | -3.338 | -1.25 | Not Significance |

Table B.55 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DLTDP and OBA on the Lightness index after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 183.210 | 9 | 20.357 | 9.03 |
| - First order terms | 165.649 | 3 | 55.216 | 24.49 |
| - Second order terms | 17.561 | 6 | 2.927 | 1.30 |
| Error | 22.542 | 10 | 2.254 | |
| - Lack of fit | 18.954 | 5 | 3.791 | 5.28 |
| - Pure error | 3.588 | 5 | 0.718 | |
| Total | 205.752 | 19 | $R^2 = 0.8904$ | |

Table B.56 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Lightness index after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 82.806 | 135.24 | Significance |
| $b_1$ | -3.202 | -7.88 | Significance |
| $b_2$ | -0.039 | -0.10 | Not Significance |
| $b_3$ | 1.370 | 3.37 | Significance |
| $b_{11}$ | 0.004 | 0.01 | Not Significance |
| $b_{22}$ | 0.579 | 1.46 | Not Significance |
| $b_{33}$ | -0.616 | -1.56 | Not Significance |
| $b_{12}$ | 0.839 | 1.58 | Not Significance |
| $b_{13}$ | 0.064 | 0.12 | Not Significance |
| $b_{23}$ | -0.241 | -0.45 | Not Significance |

Table B.57 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DLTDP and OBA on the Lightness index after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 208.909 | 9 | 23.212 | 11.73 |
| - First order terms | 183.623 | 3 | 61.208 | 30.92 |
| - Second order terms | 25.286 | 6 | 4.214 | 2.13 |
| Error | 19.793 | 10 | 1.979 | |
| - Lack of fit | 13.898 | 5 | 2.780 | 2.36 |
| - Pure error | 5.896 | 5 | 1.179 | |
| Total | 228.702 | 19 | $R^2 = 0.9135$ | |

Table B.58 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Lightness index after the third pass at the level of significant of 0.05.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.05/2,10} = 1.812$) |
|---|---|---|---|
| $b_0$ | 79.092 | 137.86 | Significance |
| $b_1$ | -3.183 | -8.36 | Significance |
| $b_2$ | -0.254 | -0.67 | Not Significance |
| $b_3$ | 1.803 | 4.74 | Significance |
| $b_{11}$ | 0.129 | -0.35 | Not Significance |
| $b_{22}$ | 0.557 | 1.50 | Not Significance |
| $b_{33}$ | -0.815 | -2.20 | Significance |
| $b_{12}$ | 0.866 | 1.74 | Not Significance |
| $b_{13}$ | 0.384 | 0.77 | Not Significance |
| $b_{23}$ | -0.554 | -1.11 | Not Significance |

Table B.59 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DLTDP and OBA on the Lightness index after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 218.784 | 9 | 24.309 | 9.73 |
| - First order terms | 190.511 | 3 | 63.504 | 25.43 |
| - Second order terms | 28.273 | 6 | 4.712 | 1.89 |
| Error | 24.974 | 10 | 2.497 | |
| - Lack of fit | 19.094 | 5 | 3.819 | 3.25 |
| - Pure error | 5.880 | 5 | 1.176 | |
| Total | 243.758 | 19 | $R^2 = 0.8975$ | |

Table B.60 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Lightness index after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 76.077 | 118.05 | Significance |
| $b_1$ | -3.152 | -7.37 | Significance |
| $b_2$ | -0.019 | -0.04 | Not Significance |
| $b_3$ | 2.004 | 4.69 | Significance |
| $b_{11}$ | -0.423 | -1.02 | Not Significance |
| $b_{22}$ | 0.289 | 0.70 | Not Significance |
| $b_{33}$ | -0.923 | -2.22 | Not Significance |
| $b_{12}$ | 0.801 | 1.43 | Not Significance |
| $b_{13}$ | 0.056 | 0.10 | Not Significance |
| $b_{23}$ | -0.919 | -1.64 | Not Significance |

Table B.61 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DLTDP and OBA on the Melt Flow Rate after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.002081 | 9 | 0.000231 | 4.51 |
| - First order terms | 0.000095 | 3 | 0.000032 | 0.62 |
| - Second order terms | 0.001986 | 6 | 0.000331 | 6.45 |
| Error | 0.000513 | 10 | 0.000051 | |
| - Lack of fit | 0.000447 | 5 | 0.000089 | 6.69 |
| - Pure error | 0.000067 | 5 | 0.000013 | |
| Total | 0.002594 | 19 | $R^2 = 0.8022$ | |

Table B.62 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Melt Flow Rate after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.19069 | 65.27 | Significance |
| $b_1$ | 0.00066 | 0.34 | Not Significance |
| $b_2$ | -0.00076 | -0.39 | Not Significance |
| $b_3$ | 0.00244 | 1.26 | Not Significance |
| $b_{11}$ | 0.00144 | 0.76 | Not Significance |
| $b_{22}$ | 0.00094 | 0.50 | Not Significance |
| $b_{33}$ | 0.00114 | 0.60 | Not Significance |
| $b_{12}$ | -0.00209 | -0.82 | Not Significance |
| $b_{13}$ | 0.00406 | 1.60 | Not Significance |
| $b_{23}$ | -0.01486 | -5.87 | Significance |

Table B.63 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DLTDP and OBA on the Melt Flow Rate after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.005865 | 9 | 0.000652 | 7.67 |
| - First order terms | 0.000118 | 3 | 0.000039 | 0.46 |
| - Second order terms | 0.005746 | 6 | 0.000958 | 11.27 |
| Error | 0.000850 | 10 | 0.000085 | |
| - Lack of fit | 0.000728 | 5 | 0.000146 | 5.99 |
| - Pure error | 0.000122 | 5 | 0.000024 | |
| Total | 0.006714 | 19 | $R^2 = 0.8734$ | |

Table B.64 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Melt Flow Rate after the third pass at the level of significant of 0.05.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.05/2,10} = 1.812$) |
|---|---|---|---|
| $b_0$ | 0.24191 | 64.35 | Significance |
| $b_1$ | 0.00236 | 0.94 | Not Significance |
| $b_2$ | -0.00173 | -0.69 | Not Significance |
| $b_3$ | 0.00038 | 0.15 | Not Significance |
| $b_{11}$ | 0.00257 | 1.06 | Not Significance |
| $b_{22}$ | 0.00503 | 2.07 | Significance |
| $b_{33}$ | 0.00549 | 2.26 | Significance |
| $b_{12}$ | -0.00098 | -0.30 | Not Significance |
| $b_{13}$ | 0.00258 | 0.79 | Not Significance |
| $b_{23}$ | -0.02480 | -7.61 | Significance |

Table B.65 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DLTDP and OBA on the Melt Flow Rate after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.005773 | 9 | 0.000641 | 7.51 |
| - First order terms | 0.000406 | 3 | 0.000135 | 1.58 |
| - Second order terms | 0.005367 | 6 | 0.000895 | 10.47 |
| Error | 0.000854 | 10 | 0.000085 | |
| - Lack of fit | 0.000748 | 5 | 0.000150 | 7.05 |
| - Pure error | 0.000106 | 5 | 0.000021 | |
| Total | 0.00662693 | 19 | $R^2 = 0.8711$ | |

Table B.66 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Melt Flow Rate after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.27725 | 73.56 | Significance |
| $b_1$ | -0.00434 | -1.73 | Not Significance |
| $b_2$ | -0.00116 | -0.46 | Not Significance |
| $b_3$ | 0.00310 | 1.24 | Not Significance |
| $b_{11}$ | 0.00499 | 2.05 | Not Significance |
| $b_{22}$ | 0.00630 | 2.59 | Significance |
| $b_{33}$ | 0.00743 | 3.05 | Significance |
| $b_{12}$ | 0.00354 | 1.08 | Not Significance |
| $b_{13}$ | -0.00326 | 0.10 | Not Significance |
| $b_{23}$ | -0.02159 | -6.61 | Significance |

Table B.67 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DLTDP and OBA on the Oxidative Induction Time after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 1778.389 | 9 | 197.599 | 7.31 |
| - First order terms | 797.339 | 3 | 265.780 | 9.83 |
| - Second order terms | 981.050 | 6 | 163.508 | 6.05 |
| Error | 270.249 | 10 | 27.025 | |
| - Lack of fit | 234.335 | 5 | 46.867 | 6.53 |
| - Pure error | 35.913 | 5 | 7.183 | |
| Total | 2048.638 | 19 | $R^2 = 0.8681$ | |

Table B.68 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Oxidative Induction Time after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 74.923 | 35.34 | Significance |
| $b_1$ | 4.117 | 2.93 | Significance |
| $b_2$ | -5.384 | -3.83 | Significance |
| $b_3$ | -3.528 | -2.51 | Significance |
| $b_{11}$ | -6.910 | -5.05 | Significance |
| $b_{22}$ | 0.462 | 0.34 | Not Significance |
| $b_{33}$ | -4.753 | -3.47 | Significance |
| $b_{12}$ | 0.463 | 0.25 | Not Significance |
| $b_{13}$ | -0.838 | -0.46 | Not Significance |
| $b_{23}$ | -1.188 | -0.65 | Not Significance |

Table B.69 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DLTDP and OBA on the Oxidative Induction Time after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 1680.449 | 9 | 186.717 | 5.48 |
| - First order terms | 1164.886 | 3 | 388.295 | 11.40 |
| - Second order terms | 515.563 | 6 | 85.927 | 2.52 |
| Error | 340.589 | 10 | 34.059 | |
| - Lack of fit | 297.581 | 5 | 59.516 | 6.92 |
| - Pure error | 43.008 | 5 | 8.602 | |
| Total | 2021.038 | 19 | $R^2 = 0.8315$ | |

Table B.70 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Oxidative Induction Time after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 65.842 | 27.67 | Significance |
| $b_1$ | 6.548 | 4.15 | Significance |
| $b_2$ | -5.877 | -3.72 | Significance |
| $b_3$ | -2.805 | 1.78 | Not Significance |
| $b_{11}$ | -4.655 | -3.03 | Significance |
| $b_{22}$ | -1.332 | -0.87 | Not Significance |
| $b_{33}$ | -4.019 | -2.61 | Significance |
| $b_{12}$ | 1.125 | 0.55 | Not Significance |
| $b_{13}$ | -0.400 | -0.19 | Not Significance |
| $b_{23}$ | 0.650 | 0.32 | Not Significance |

Table B.71 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DLTDP and OBA on the Oxidative Induction Time after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 2788.322 | 9 | 309.814 | 7.35 |
| - First order terms | 1858.934 | 3 | 619.645 | 14.69 |
| - Second order terms | 929.389 | 6 | 154.898 | 3.67 |
| Error | 421.743 | 10 | 42.174 | |
| - Lack of fit | 365.335 | 5 | 73.067 | 6.48 |
| - Pure error | 56.408 | 5 | 11.282 | |
| Total | 3210.066 | 19 | $R^2 = 0.8686$ | |

Table B.72 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Oxidative Induction Time after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 58.517 | 22.10 | Significance |
| $B_1$ | 6.924 | 3.94 | Significance |
| $b_2$ | -9.276 | -5.28 | Significance |
| $b_3$ | -1.462 | -0.83 | Not Significance |
| $b_{11}$ | -3.304 | -1.93 | Not Significance |
| $b_{22}$ | 3.378 | 1.97 | Not Significance |
| $b_{33}$ | -3.781 | -2.21 | Not Significance |
| $b_{12}$ | 2.538 | 1.11 | Not Significance |
| $b_{13}$ | -6.188 | -2.69 | Significance |
| $b_{23}$ | 0.688 | 0.30 | Not Significance |

Table B.73 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DSTDP and OBA on the Lightness index after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 171.610 | 9 | 19.068 | 9.93 |
| - First order terms | 140.942 | 3 | 46.981 | 24.46 |
| - Second order terms | 30.669 | 6 | 5.111 | 2.66 |
| Error | 19.210 | 10 | 1.921 | |
| - Lack of fit | 16.755 | 5 | 3.351 | 6.83 |
| - Pure error | 2.454 | 5 | 0.491 | |
| Total | 190.820 | 19 | $R^2 = 0.8993$ | |

Table B.74 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Lightness index after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 83.505 | 147.74 | Significance |
| $b_1$ | -2.644 | -7.05 | Significance |
| $b_2$ | -0.593 | -1.58 | Not Significance |
| $b_3$ | 1.725 | 4.60 | Significance |
| $b_{11}$ | -0.743 | -2.04 | Not Significance |
| $b_{22}$ | 0.043 | 0.12 | Not Significance |
| $b_{33}$ | 0.035 | 0.09 | Not Significance |
| $b_{12}$ | 0.409 | 0.83 | Not Significance |
| $b_{13}$ | 1.616 | 3.30 | Significance |
| $b_{23}$ | 0.129 | 0.26 | Not Significance |

Table B.75 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DSTDP and OBA on the Lightness index after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 182.645 | 9 | 20.294 | 7.33 |
| - First order terms | 128.188 | 3 | 42.729 | 15.42 |
| - Second order terms | 54.457 | 6 | 9.076 | 3.28 |
| Error | 27.705 | 10 | 2.770 | |
| - Lack of fit | 23.500 | 5 | 4.700 | 5.59 |
| - Pure error | 4.205 | 5 | 0.841 | |
| Total | 210.349 | 19 | $R^2 = 0.8683$ | |

Table B.76 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Lightness index after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 79.550 | 117.20 | Significance |
| $b_1$ | -2.376 | -5.28 | Significance |
| $b_2$ | -0.858 | -1.90 | Not Significance |
| $b_3$ | 1.734 | 3.85 | Significance |
| $b_{11}$ | -1.186 | -2.71 | Significance |
| $b_{22}$ | -0.670 | -1.53 | Not Significance |
| $b_{33}$ | 0.074 | 3.85 | Significance |
| $b_{12}$ | 0.651 | 1.11 | Not Significance |
| $b_{13}$ | 1.529 | 2.60 | Significance |
| $b_{23}$ | 0.921 | 1.57 | Not Significance |

Table B.77 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DSTDP and OBA on the Lightness index after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 285.376 | 9 | 31.708 | 9.64 |
| - First order terms | 108.089 | 3 | 36.030 | 10.95 |
| - Second order terms | 177.287 | 6 | 29.548 | 8.98 |
| Error | 32.889 | 10 | 3.289 | |
| - Lack of fit | 28.453 | 5 | 5.691 | 6.41 |
| - Pure error | 4.436 | 5 | 0.887 | |
| Total | 318.265 | 19 | $R^2 = 0.8967$ | |

Table B.78 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Lightness index after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 76.626 | 103.61 | Significance |
| $b_1$ | -2.173 | -4.43 | Significance |
| $b_2$ | -0.230 | -0.47 | Not Significance |
| $b_3$ | 1.772 | 3.61 | Significance |
| $b_{11}$ | -3.038 | -6.36 | Significance |
| $b_{22}$ | -0.993 | -2.08 | Not Significance |
| $b_{33}$ | 0.462 | 0.97 | Not Significance |
| $b_{12}$ | 0.743 | -2.08 | Not Significance |
| $b_{13}$ | 1.540 | 2.40 | Significance |
| $b_{23}$ | 0.698 | 1.09 | Not Significance |

Table B.79 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DSTDP and OBA on the Melt Flow Rate after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.002001 | 9 | 0.000222 | 6.39 |
| - First order terms | 0.000940 | 3 | 0.000313 | 9.00 |
| - Second order terms | 0.001061 | 6 | 0.000177 | 5.08 |
| Error | 0.000348 | 10 | 0.000035 | |
| - Lack of fit | 0.000303 | 5 | 0.000061 | 6.70 |
| - Pure error | 0.000045 | 5 | 0.000009 | |
| Total | 0.002349 | 19 | $R^2 = 0.8518$ | |

Table B.80 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Melt Flow Rate after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.19618 | 81.53 | Significance |
| $b_1$ | 0.00351 | 2.20 | Not Significance |
| $b_2$ | 0.00596 | 3.74 | Significance |
| $b_3$ | -0.00457 | -2.86 | Significance |
| $b_{11}$ | -0.00244 | -1.57 | Not Significance |
| $b_{22}$ | -0.00196 | -1.26 | Not Significance |
| $b_{33}$ | 0.00349 | 2.24 | Significance |
| $b_{12}$ | -0.00040 | -0.19 | Not Significance |
| $b_{13}$ | -0.00605 | -2.90 | Significance |
| $b_{23}$ | -0.00723 | -3.46 | Significance |

Table B.81 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DSTDP and OBA on the Melt Flow Rate after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.004697 | 9 | 0.000522 | 3.38 |
| - First order terms | 0.000942 | 3 | 0.000314 | 2.03 |
| - Second order terms | 0.003756 | 6 | 0.000626 | 4.06 |
| Error | 0.001543 | 10 | 0.000154 | |
| - Lack of fit | 0.001344 | 5 | 0.000269 | 6.75 |
| - Pure error | 0.000199 | 5 | 0.000040 | |
| Total | 0.006240 | 19 | $R^2 = 0.7527$ | |

Table B.82 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Melt Flow Rate after the third pass at the level of significant of 0.05.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.05/2,10} = 1.812$) |
|---|---|---|---|
| $b_0$ | 0.25185 | 49.72 | Significance |
| $b_1$ | -0.00009 | -0.03 | Not Significance |
| $b_2$ | -0.00447 | -1.33 | Not Significance |
| $b_3$ | 0.00700 | 2.08 | Significance |
| $b_{11}$ | -0.00321 | -0.98 | Not Significance |
| $b_{22}$ | -0.00689 | -2.11 | Significance |
| $b_{33}$ | 0.00714 | 2.18 | Significance |
| $b_{12}$ | -0.00058 | -0.13 | Not Significance |
| $b_{13}$ | -0.01550 | -3.53 | Significance |
| $b_{23}$ | -0.00355 | -0.81 | Not Significance |

Table B.83 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DSTDP and OBA on the Melt Flow Rate after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.008714 | 9 | 0.000968 | 4.50 |
| - First order terms | 0.005534 | 3 | 0.001845 | 8.57 |
| - Second order terms | 0.003180 | 6 | 0.000530 | 2.46 |
| Error | 0.002153 | 10 | 0.000215 | |
| - Lack of fit | 0.001872 | 5 | 0.000374 | 6.65 |
| - Pure error | 0.000281 | 5 | 0.000056 | |
| Total | 0.010867 | 19 | $R^2 = 0.8019$ | |

Table B.84 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Melt Flow Rate after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.29211 | 48.82 | Significance |
| $b_1$ | -0.01998 | -5.03 | Significance |
| $b_2$ | -0.00076 | -0.19 | Not Significance |
| $b_3$ | 0.00237 | 0.60 | Not Significance |
| $b_{11}$ | -0.00021 | -0.05 | Not Significance |
| $b_{22}$ | -0.00889 | -2.30 | Significance |
| $b_{33}$ | 0.00554 | 1.43 | Not Significance |
| $b_{12}$ | -0.00330 | -0.64 | Not Significance |
| $b_{13}$ | -0.00795 | -1.53 | Not Significance |
| $b_{23}$ | -0.01030 | -1.99 | Not Significance |

Table B.85 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DSTDP and OBA on the Oxidative Induction Time after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 3934.710 | 9 | 437.190 | 13.81 |
| - First order terms | 2142.193 | 3 | 714.064 | 22.55 |
| - Second order terms | 1792.516 | 6 | 298.753 | 9.44 |
| Error | 316.590 | 10 | 31.659 | |
| - Lack of fit | 204.342 | 5 | 40.868 | 1.82 |
| - Pure error | 112.248 | 5 | 22.450 | |
| Total | 4251.300 | 19 | $R^2 = 0.9255$ | |

Table B.86 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Oxidative Induction Time after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 71.697 | 31.25 | Significance |
| $b_1$ | 4.999 | 3.28 | Significance |
| $b_2$ | -10.644 | -6.99 | Significance |
| $b_3$ | 4.311 | 2.83 | Significance |
| $b_{11}$ | -7.138 | -4.82 | Significance |
| $b_{22}$ | -4.221 | -2.85 | Significance |
| $b_{33}$ | 1.259 | 0.85 | Not Significance |
| $b_{12}$ | -4.863 | -2.44 | Significance |
| $b_{13}$ | -8.713 | -4.38 | Significance |
| $b_{23}$ | 0.838 | 0.42 | Not Significance |

Table B.87 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DSTDP and OBA on the Oxidative Induction Time after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 2504.527 | 9 | 278.281 | 11.38 |
| - First order terms | 1773.675 | 3 | 591.225 | 24.18 |
| - Second order terms | 730.852 | 6 | 121.809 | 4.98 |
| Error | 244.494 | 10 | 24.449 | |
| - Lack of fit | 186.825 | 5 | 37.365 | 3.24 |
| - Pure error | 57.668 | 5 | 11.534 | |
| Total | 2749.020 | 19 | $R^2 = 0.9111$ | |

Table B.88 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Oxidative Induction Time after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 60.548 | 30.03 | Significance |
| $b_1$ | 3.480 | 2.60 | Significance |
| $b_2$ | -10.657 | -7.96 | Significance |
| $b_3$ | 2.049 | 1.53 | Not Significance |
| $b_{11}$ | -4.661 | -3.58 | Significance |
| $b_{22}$ | -1.533 | -1.18 | Not Significance |
| $b_{33}$ | -1.639 | -1.26 | Not Significance |
| $b_{12}$ | -2.150 | -1.23 | Not Significance |
| $b_{13}$ | -5.850 | -3.35 | Significance |
| $b_{23}$ | 3.025 | 1.73 | Not Significance |

Table B.89 : ANOVA table for the multiple regression analysis of the interactions of ODHP, DSTDP and OBA on the Oxidative Induction Time after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 2626.031 | 9 | 291.781 | 9.72 |
| - First order terms | 1344.372 | 3 | 448.124 | 14.93 |
| - Second order terms | 1281.659 | 6 | 213.610 | 7.12 |
| Error | 300.159 | 10 | 30.016 | |
| - Lack of fit | 215.091 | 5 | 43.018 | 2.53 |
| - Pure error | 85.068 | 5 | 17.014 | |
| Total | 2926.190 | 19 | $R^2 = 0.8974$ | |

Table B.90 : Statistic-$t_0$ of coefficients testing for interactions of ODHP, DSTDP and OBA on the Oxidative Induction Time after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 65.542 | 29.34 | Significance |
| $b_1$ | 2.167 | 1.46 | Not Significance |
| $b_2$ | -9.682 | -6.53 | Significance |
| $b_3$ | 0.085 | 0.06 | Not Significance |
| $b_{11}$ | -7.438 | -5.15 | Significance |
| $b_{22}$ | -4.892 | -3.39 | Significance |
| $b_{33}$ | -3.036 | -2.10 | Not Significance |
| $b_{12}$ | -1.338 | -0.69 | Not Significance |
| $b_{13}$ | -4.338 | -2.24 | Significance |
| $b_{23}$ | 1.338 | 0.69 | Not Significance |

Table B.91 : ANOVA table for the multiple regression analysis of the interactions of DAT, DLTDP and OBA on the Lightness index after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 1187.709 | 9 | 131.968 | 14.65 |
| - First order terms | 1042.026 | 3 | 347.342 | 38.55 |
| - Second order terms | 145.683 | 6 | 24.280 | 2.69 |
| Error | 90.099 | 10 | 9.010 | |
| - Lack of fit | 75.990 | 5 | 15.198 | 5.39 |
| - Pure error | 14.110 | 5 | 2.822 | |
| Total | 1277.808 | 19 | $R^2 = 0.9295$ | |

Table B.92 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DLTDP and OBA on the Lightness index after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 70.707 | 57.76 | Significance |
| $b_1$ | -8.707 | -10.72 | Significance |
| $b_2$ | 0.595 | 0.73 | Not Significance |
| $b_3$ | -0.365 | -0.45 | Not Significance |
| $b_{11}$ | 1.091 | 1.38 | Not Significance |
| $b_{22}$ | -0.010 | -0.01 | Not Significance |
| $b_{33}$ | -2.352 | -2.98 | Significance |
| $b_{12}$ | -1.376 | -1.30 | Not Significance |
| $b_{13}$ | -0.981 | -0.92 | Not Significance |
| $b_{23}$ | -1.474 | -1.39 | Not Significance |

Table B.93 : ANOVA table for the multiple regression analysis of the interactions of DAT, DLTDP and OBA on the Lightness index after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 1411.925 | 9 | 156.881 | 11.74 |
| - First order terms | 1273.717 | 3 | 424.572 | 31.77 |
| - Second order terms | 138.208 | 6 | 23.035 | 1.72 |
| Error | 133.618 | 10 | 13.362 | |
| - Lack of fit | 115.931 | 5 | 23.186 | 6.55 |
| - Pure error | 17.687 | 5 | 3.537 | |
| Total | 1545.544 | 19 | $R^2 = 0.9135$ | |

Table B.94 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DLTDP and OBA on the Lightness index after the third pass at the level of significant of 0.05.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.05/2,10} = 1.182$) |
|---|---|---|---|
| $b_0$ | 60.826 | 40.80 | Significance |
| $b_1$ | -9.638 | -9.74 | Significance |
| $b_2$ | -0.367 | -0.37 | Not Significance |
| $b_3$ | -0.499 | -0.50 | Not Significance |
| $b_{11}$ | 0.758 | 0.79 | Not Significance |
| $b_{22}$ | 1.117 | 1.16 | Not Significance |
| $b_{33}$ | -1.202 | -1.25 | Not Significance |
| $b_{12}$ | -2.724 | -2.11 | Significance |
| $b_{13}$ | -1.086 | -0.84 | Not Significance |
| $b_{23}$ | -1.489 | -1.15 | Not Significance |

Table B.95 : ANOVA table for the multiple regression analysis of the interactions of DAT, DLTDP and OBA on the Lightness index after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 1369.733 | 9 | 152.193 | 8.39 |
| - First order terms | 1175.266 | 3 | 391.755 | 21.60 |
| - Second order terms | 194.468 | 6 | 32.411 | 1.79 |
| Error | 181.407 | 10 | 18.141 | |
| - Lack of fit | 157.787 | 5 | 31.557 | 6.68 |
| - Pure error | 23.620 | 5 | 4.724 | |
| Total | 1551.141 | 19 | $R^2 = 0.8830$ | |

Table B.96 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DLTDP and OBA on the Lightness index after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 54.458 | 31.35 | Significance |
| $b_1$ | -9.216 | -8.00 | Significance |
| $b_2$ | -0.503 | -0.44 | Not Significance |
| $b_3$ | -0.930 | -0.81 | Not Significance |
| $b_{11}$ | 1.007 | 0.90 | Not Significance |
| $b_{22}$ | 1.771 | 1.58 | Not Significance |
| $b_{33}$ | -0.439 | -0.39 | Not Significance |
| $b_{12}$ | -3.646 | -2.42 | Significance |
| $b_{13}$ | -1.331 | -0.88 | Not Significance |
| $b_{23}$ | -1.209 | -0.80 | Not Significance |

Table B.97 : ANOVA table for the multiple regression analysis of the interactions of DAT, DLTDP and OBA on the Melt Flow Rate after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.006721 | 9 | 0.000747 | 4.52 |
| - First order terms | 0.001208 | 3 | 0.000403 | 2.44 |
| - Second order terms | 0.005513 | 6 | 0.000919 | 5.56 |
| Error | 0.001651 | 10 | 0.000165 | |
| - Lack of fit | 0.001444 | 5 | 0.000289 | 6.98 |
| - Pure error | 0.000207 | 5 | 0.000041 | |
| Total | 0.008372 | 19 | $R^2 = 0.8028$ | |

Table B.98 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DLTDP and OBA on the Melt Flow Rate after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.14816 | 28.27 | Significance |
| $b_1$ | -0.00887 | -2.55 | Significance |
| $b_2$ | -0.00206 | -0.59 | Not Significance |
| $b_3$ | -0.00236 | -0.68 | Not Significance |
| $b_{11}$ | 0.01335 | 3.94 | Significance |
| $b_{22}$ | 0.00981 | 2.90 | Significance |
| $b_{33}$ | 0.01030 | 3.04 | Significance |
| $b_{12}$ | -0.00455 | 1.00 | Not Significance |
| $b_{13}$ | -0.00503 | -1.11 | Not Significance |
| $b_{23}$ | -0.00823 | -1.81 | Not Significance |

Table B.99 : ANOVA table for the multiple regression analysis of the interactions of DAT, DLTDP and OBA on the Melt Flow Rate after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.005659 | 9 | 0.000629 | 6.13 |
| - First order terms | 0.001205 | 3 | 0.000402 | 3.91 |
| - Second order terms | 0.004454 | 6 | 0.000742 | 7.24 |
| Error | 0.001026 | 10 | 0.000103 | |
| - Lack of fit | 0.000899 | 5 | 0.000180 | 7.08 |
| - Pure error | 0.000127 | 5 | 0.000025 | |
| Total | 0.006684 | 19 | $R^2 = 0.8465$ | |

Table B.100 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DLTDP and OBA on the Melt Flow Rate after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.18510 | 44.81 | Significance |
| $b_1$ | -0.00865 | -3.16 | Significance |
| $b_2$ | -0.00193 | -0.71 | NotSignificance |
| $b_3$ | -0.00310 | -1.13 | Not Significance |
| $b_{11}$ | 0.01198 | 4.49 | Significance |
| $b_{22}$ | 0.00666 | 2.50 | Significance |
| $b_{33}$ | 0.00924 | 3.46 | Significance |
| $b_{12}$ | -0.00401 | -1.12 | Not Significance |
| $b_{13}$ | -0.00581 | -1.62 | Not Significance |
| $b_{23}$ | -0.00944 | -2.64 | Significance |

Table B.101 : ANOVA table for the multiple regression analysis of the interactions of DAT, DLTDP and OBA on the Melt Flow Rate after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.009593 | 9 | 0.001066 | 5.34 |
| - First order terms | 0.002317 | 3 | 0.000772 | 3.87 |
| - Second order terms | 0.007276 | 6 | 0.001213 | 6.08 |
| Error | 0.001994 | 10 | 0.000199 | |
| - Lack of fit | 0.001740 | 5 | 0.000348 | 6.83 |
| - Pure error | 0.000255 | 5 | 0.000051 | |
| Total | 0.011588 | 19 | $R^2 = 0.8279$ | |

Table B.102 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DLTDP and OBA on the Melt Flow Rate after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.20018 | 34.76 | Significance |
| $b_1$ | -0.01229 | -3.22 | Significance |
| $b_2$ | -0.00370 | -0.97 | Not Significance |
| $b_3$ | -0.00222 | -0.58 | Not Significance |
| $b_{11}$ | 0.01842 | 4.95 | Significance |
| $b_{22}$ | 0.00673 | 1.81 | Not Significance |
| $b_{33}$ | 0.00890 | 2.39 | Significance |
| $b_{12}$ | -0.00735 | -1.47 | Not Significance |
| $b_{13}$ | -0.00668 | -1.34 | Not Significance |
| $b_{23}$ | -0.00870 | -1.74 | Not Significance |

Table B.103 : ANOVA table for the multiple regression analysis of the interactions of DAT, DLTDP and OBA on the Oxidative Induction Time after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 3741.209 | 9 | 415.690 | 11.83 |
| - First order terms | 3315.012 | 3 | 1105.004 | 31.44 |
| - Second order terms | 426.197 | 6 | 71.033 | 2.02 |
| Error | 351.508 | 10 | 35.151 | |
| - Lack of fit | 287.440 | 5 | 57.488 | 4.49 |
| - Pure error | 64.068 | 5 | 12.814 | |
| Total | 4092.718 | 19 | $R^2 = 0.9141$ | |

Table B.104 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DLTDP and OBA on the Oxidative Induction Time after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 84.248 | 34.85 | Significance |
| $b_1$ | 14.008 | 8.73 | Significance |
| $b_2$ | -5.575 | -3.47 | Significance |
| $b_3$ | 3.929 | 2.45 | Significance |
| $b_{11}$ | -2.133 | -1.37 | Not Significance |
| $b_{22}$ | 2.746 | 1.76 | Not Significance |
| $b_{33}$ | 2.941 | 1.88 | Not Significance |
| $b_{12}$ | -1.950 | -0.93 | Not Significance |
| $b_{13}$ | -1.350 | -0.64 | Not Significance |
| $b_{23}$ | 2.875 | 1.37 | Not Significance |

Table B.105 : ANOVA table for the multiple regression analysis of the interactions of DAT, DLTDP and OBA on the Oxidative Induction Time after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 4994.457 | 9 | 554.940 | 17.69 |
| - First order terms | 2977.245 | 3 | 992.415 | 31.64 |
| - Second order terms | 2017.212 | 6 | 336.202 | 10.72 |
| Error | 313.640 | 10 | 31.364 | |
| - Lack of fit | 272.580 | 5 | 54.516 | 6.64 |
| - Pure error | 41.060 | 5 | 8.212 | |
| Total | 5308.098 | 19 | $R^2 = 0.9409$ | |

Table B.106 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DLTDP and OBA on the Oxidative Induction Time after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 77.844 | 34.09 | Significance |
| $b_1$ | 12.009 | 7.92 | Significance |
| $b_2$ | -8.551 | -5.64 | Significance |
| $b_3$ | 0.823 | 0.54 | Not Significance |
| $b_{11}$ | -5.450 | 3.69 | Significance |
| $b_{22}$ | 7.278 | 4.93 | Significance |
| $b_{33}$ | 3.636 | 2.46 | Significance |
| $b_{12}$ | -5.863 | -2.96 | Significance |
| $b_{13}$ | 0.913 | 0.46 | Not Significance |
| $b_{23}$ | 5.488 | 2.77 | Not Significance |

Table B.107 : ANOVA table for the multiple regression analysis of the interactions of DAT, DLTDP and OBA on the Oxidative Induction Time after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 5757.161 | 9 | 639.685 | 16.81 |
| - First order terms | 3680.168 | 3 | 1226.723 | 32.23 |
| - Second order terms | 2076.994 | 6 | 346.166 | 9.10 |
| Error | 380.589 | 10 | 38.059 | |
| - Lack of fit | 326.196 | 5 | 65.239 | 6.00 |
| - Pure error | 54.393 | 5 | 10.879 | |
| Total | 6137.750 | 19 | $R^2 = 0.9380$ | |

Table B.108 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DLTDP and OBA on the Oxidative Induction Time after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 77.175 | 30.68 | Significance |
| $b_1$ | 14.574 | 8.73 | Significance |
| $b_2$ | -6.765 | -4.05 | Significance |
| $b_3$ | -3.362 | -2.01 | Not Significance |
| $b_{11}$ | -7.549 | -4.65 | Significance |
| $b_{22}$ | 6.098 | 3.75 | Significance |
| $b_{33}$ | 1.414 | 0.87 | NotSignificance |
| $b_{12}$ | -0.700 | -0.32 | Not Significance |
| $b_{13}$ | 2.875 | 1.32 | Not Significance |
| $b_{23}$ | 7.650 | 3.51 | Significance |

Table B.109 : ANOVA table for the multiple regression analysis of the interactions of DAT, DSTDP and OBA on the Lightness index after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 1043.712 | 9 | 115.968 | 15.16 |
| - First order terms | 975.002 | 3 | 325.001 | 42.48 |
| - Second order terms | 68.710 | 6 | 11.452 | 1.50 |
| Error | 76.504 | 10 | 7.650 | |
| - Lack of fit | 53.749 | 5 | 10.750 | 2.36 |
| - Pure error | 22.755 | 5 | 4.551 | |
| Total | 1120.215 | 19 | $R^2$ = 0.9317 | |

Table B.110 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DSTDP and OBA on the Lightness index after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10}$ = 2.228) |
|---|---|---|---|
| $b_0$ | 68.724 | 60.93 | Significance |
| $b_1$ | -8.348 | -11.15 | Significance |
| $b_2$ | 0.704 | 0.94 | Not Significance |
| $b_3$ | 1.101 | 1.47 | Not Significance |
| $b_{11}$ | 1.887 | 2.59 | Significance |
| $b_{22}$ | 0.871 | 1.19 | Not Significance |
| $b_{33}$ | -0.358 | -0.49 | Not Significance |
| $b_{12}$ | -0.046 | -0.05 | Not Significance |
| $b_{13}$ | 0.606 | 0.62 | Not Significance |
| $b_{23}$ | -0.529 | -0.54 | Not Significance |

Table B.111 : ANOVA table for the multiple regression analysis of the interactions of DAT, DSTDP and OBA on the Lightness index after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 1582.606 | 9 | 175.845 | 18.05 |
| - First order terms | 1499.712 | 3 | 499.904 | 51.30 |
| - Second order terms | 82.894 | 6 | 13.816 | 1.42 |
| Error | 97.441 | 10 | 9.744 | |
| - Lack of fit | 78.480 | 5 | 15.696 | 4.14 |
| - Pure error | 18.961 | 5 | 3.792 | |
| Total | 1680.047 | 19 | $R^2$ = 0.9420 | |

Table B.112 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DSTDP and OBA on the Lightness index after the third pass at the level of significant of 0.05.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.05/2,10}$ = 1.812) |
|---|---|---|---|
| $b_0$ | 62.410 | 49.03 | Significance |
| $b_1$ | -10.329 | -12.23 | Significance |
| $b_2$ | 0.306 | 0.36 | Not Significance |
| $b_3$ | 1.739 | 2.06 | Significance |
| $b_{11}$ | 1.685 | 2.05 | Significance |
| $b_{22}$ | 0.518 | 0.63 | NotSignificance |
| $b_{33}$ | -0.599 | -0.73 | Not Significance |
| $b_{12}$ | 0.989 | 0.90 | Not Significance |
| $b_{13}$ | -1.079 | -0.98 | Not Significance |
| $b_{23}$ | -1.309 | -1.19 | Not Significance |

Table B.113 : ANOVA table for the multiple regression analysis of the interactions of DAT, DSTDP and OBA on the Lightness index after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 1606.993 | 9 | 178.555 | 9.35 |
| - First order terms | 1553.379 | 3 | 517.793 | 27.13 |
| - Second order terms | 53.615 | 6 | 8.936 | 0.47 |
| Error | 190.887 | 10 | 19.089 | |
| - Lack of fit | 165.289 | 5 | 33.058 | 6.46 |
| - Pure error | 25.597 | 5 | 5.119 | |
| Total | 1797.880 | 19 | $R^2$ = 0.8938 | |

Table B.114 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DSTDP and OBA on the Lightness index after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10}$ = 2.228) |
|---|---|---|---|
| $b_0$ | 58.219 | 32.68 | Significance |
| $b_1$ | -10.548 | -8.92 | Significance |
| $b_2$ | 1.316 | 1.11 | Not Significance |
| $b_3$ | 0.864 | 0.73 | Not Significance |
| $b_{11}$ | 1.006 | 0.87 | Not Significance |
| $b_{22}$ | 0.244 | 0.21 | Not Significance |
| $b_{33}$ | -1.471 | -1.28 | Not Significance |
| $b_{12}$ | 0.321 | 0.21 | Not Significance |
| $b_{13}$ | -0.264 | -0.17 | Not Significance |
| $b_{23}$ | 0.261 | 0.17 | Not Significance |

Table B.115 : ANOVA table for the multiple regression analysis of the interactions of DAT, DSTDP and OBA on the Melt Flow Rate after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.000866 | 9 | 0.000096 | 5.44 |
| - First order terms | 0.000595 | 3 | 0.000198 | 11.22 |
| - Second order terms | 0.000271 | 6 | 0.000045 | 2.55 |
| Error | 0.000177 | 10 | 0.000018 | |
| - Lack of fit | 0.000155 | 5 | 0.000031 | 6.93 |
| - Pure error | 0.000022 | 5 | 0.000004 | |
| Total | 0.001043 | 19 | $R^2 = 0.8304$ | |

Table B.116 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DSTDP and OBA on the Melt Flow Rate after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.16831 | 98.13 | Significance |
| $b_1$ | -0.00607 | -5.33 | Significance |
| $b_2$ | 0.00238 | 2.09 | Not Significance |
| $b_3$ | 0.00104 | 0.92 | Not Significance |
| $b_{11}$ | 0.00105 | 0.95 | Not Significance |
| $b_{22}$ | -0.00234 | -2.12 | Not Significance |
| $b_{33}$ | 0.00107 | 0.96 | Not Significance |
| $b_{12}$ | -0.00176 | -1.19 | Not Significance |
| $b_{13}$ | -0.00181 | -1.22 | Not Significance |
| $b_{23}$ | 0.00346 | 2.33 | Significance |

Table B.117 : ANOVA table for the multiple regression analysis of the interactions of DAT, DSTDP and OBA on the Melt Flow Rate after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.000303 | 9 | 0.000034 | 13.51 |
| - First order terms | 0.000243 | 3 | 0.000081 | 32.49 |
| - Second order terms | 0.000060 | 6 | 0.000010 | 4.02 |
| Error | 0.000025 | 10 | 0.000002 | |
| - Lack of fit | 0.000020 | 5 | 0.000004 | 3.88 |
| - Pure error | 0.000005 | 5 | 0.000001 | |
| Total | 0.000328 | 19 | $R^2 = 0.9240$ | |

Table B.118 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DSTDP and OBA on the Melt Flow Rate after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.19543 | 303.70 | Significance |
| $b_1$ | -0.00408 | -9.56 | Significance |
| $b_2$ | 0.00033 | 0.77 | Not Significance |
| $b_3$ | -0.00100 | -2.35 | Significance |
| $b_{11}$ | 0.00119 | 2.87 | Significance |
| $b_{22}$ | 0.00057 | 1.38 | Not Significance |
| $b_{33}$ | 0.00034 | 0.82 | Not Significance |
| $b_{12}$ | -0.00101 | -1.82 | Not Significance |
| $b_{13}$ | -0.00186 | -3.34 | Significance |
| $b_{23}$ | 0.00016 | 0.29 | Not Significance |

Table B.119 : ANOVA table for the multiple regression analysis of the interactions of DAT, DSTDP and OBA on the Melt Flow Rate after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 0.002480 | 9 | 0.000276 | 10.96 |
| - First order terms | 0.001418 | 3 | 0.000473 | 18.79 |
| - Second order terms | 0.001062 | 6 | 0.000177 | 7.04 |
| Error | 0.000252 | 10 | 0.000025 | |
| - Lack of fit | 0.000194 | 5 | 0.000039 | 3.40 |
| - Pure error | 0.000057 | 5 | 0.000011 | |
| Total | 0.002732 | 19 | $R^2 = 0.9079$ | |

Table B.120 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DSTDP and OBA on the Melt Flow Rate after the fifth pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 0.21458 | 104.92 | Significance |
| $b_1$ | -0.00978 | -7.00 | Significance |
| $b_2$ | -0.00163 | -1.20 | Not Significance |
| $b_3$ | -0.00237 | -1.74 | Not Significance |
| $b_{11}$ | 0.00680 | 5.14 | Significance |
| $b_{22}$ | -0.00399 | -3.02 | Significance |
| $b_{33}$ | -0.00040 | -0.30 | Not Significance |
| $b_{12}$ | -0.00061 | -0.35 | Not Significance |
| $b_{13}$ | -0.00064 | -0.36 | Not Significance |
| $b_{23}$ | -0.00291 | -1.64 | Not Significance |

Table B.121 : ANOVA table for the multiple regression analysis of the interactions of DAT, DSTDP and OBA on the Oxidative Induction Time after the first pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_o$ |
|---|---|---|---|---|
| Regression | 4344.370 | 9 | 482.708 | 16.24 |
| - First order terms | 2176.498 | 3 | 725.499 | 24.41 |
| - Second order terms | 2167.872 | 6 | 361.312 | 12.15 |
| Error | 297.270 | 10 | 29.727 | |
| - Lack of fit | 258.557 | 5 | 51.711 | 6.68 |
| - Pure error | 38.713 | 5 | 7.743 | |
| Total | 4641.640 | 19 | $R^2 = 0.9360$ | |

Table B.122 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DSTDP and OBA on the Oxidative Induction Time after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 93.638 | 42.11 | Significance |
| $b_1$ | 10.915 | 7.40 | Significance |
| $b_2$ | -5.746 | -3.89 | Significance |
| $b_3$ | 2.686 | 1.82 | Not Significance |
| $b_{11}$ | -10.451 | -7.28 | Significance |
| $b_{22}$ | 4.645 | 3.23 | Significance |
| $b_{33}$ | 1.357 | 0.95 | Not Significance |
| $b_{12}$ | 0.113 | 0.06 | Not Significance |
| $b_{13}$ | -1.363 | -0.71 | Not Significance |
| $b_{23}$ | -2.663 | -1.38 | Not Significance |

Table B.123 : ANOVA table for the multiple regression analysis of the interactions of DAT, DSTDP and OBA on the Oxidative Induction Time after the third pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 3568.358 | 9 | 396.484 | 6.88 |
| - First order terms | 3009.167 | 3 | 1003.056 | 17.42 |
| - Second order terms | 559.192 | 6 | 93.199 | 1.62 |
| Error | 575.939 | 10 | 57.594 | |
| - Lack of fit | 500.786 | 5 | 100.157 | 6.66 |
| - Pure error | 75.153 | 5 | 15.031 | |
| Total | 4144.298 | 19 | $R^2 = 0.8610$ | |

Table B.124 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DSTDP and OBA on the Oxidative Induction Time after the third pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 86.792 | 28.04 | Significance |
| $b_1$ | 13.986 | 6.81 | Significance |
| $b_2$ | -4.864 | -2.37 | Significance |
| $b_3$ | 1.037 | 0.50 | Not Significance |
| $b_{11}$ | -4.906 | -2.45 | Significance |
| $b_{22}$ | 2.766 | 1.38 | Not Significance |
| $b_{33}$ | -1.618 | -0.81 | Not Significance |
| $b_{12}$ | -1.025 | -0.38 | Not Significance |
| $b_{13}$ | 0.325 | 0.12 | Not Significance |
| $b_{23}$ | 1.550 | 0.58 | Not Significance |

Table B.125 : ANOVA table for the multiple regression analysis of the interactions of DAT, DSTDP and OBA on the Oxidative Induction Time after the fifth pass.

| Source of Variation | Sum of Square | Degree of freedom | Mean Square | $F_0$ |
|---|---|---|---|---|
| Regression | 3353.332 | 9 | 372.592 | 10.02 |
| - First order terms | 3074.549 | 3 | 1024.850 | 27.57 |
| - Second order terms | 278.784 | 6 | 46.464 | 1.25 |
| Error | 371.770 | 10 | 37.177 | |
| - Lack of fit | 321.661 | 5 | 64.332 | 6.42 |
| - Pure error | 50.108 | 5 | 10.022 | |
| Total | 3725.102 | 19 | $R^2 = 0.9002$ | |

Table B.126 : Statistic-$t_0$ of coefficients testing for interactions of DAT, DSTDP and OBA on the Oxidative Induction Time after the first pass at the level of significant of 0.025.

| Regression Coefficients | | $t_0$ | Hypothesis test ($t_{0.025/2,10} = 2.228$) |
|---|---|---|---|
| $b_0$ | 80.003 | 32.18 | Significance |
| $b_1$ | 12.923 | 7.83 | Significance |
| $b_2$ | -7.552 | -4.58 | Significance |
| $b_3$ | 1.046 | 0.63 | Not Significance |
| $b_{11}$ | -3.184 | -1.98 | Not Significance |
| $b_{22}$ | 1.465 | 0.91 | Not Significance |
| $b_{33}$ | -2.283 | -1.42 | Not Significance |
| $b_{12}$ | 0.313 | 0.14 | Not Significance |
| $b_{13}$ | -1.438 | -0.67 | Not Significance |
| $b_{23}$ | 0.588 | 0.27 | Not Significance |

# APPENDIX C

## Calculation Method

Plastic composition design experimentation by central composite rotatable design will test several properties. In analyzing and calculating the result of each response, the same method will be used in each experimentation. Therefore, an example will be shown only on the calculation and the analysis method of Lightness index after the first pass of compounded HDPE with PATHP, DSTDP and OBA.

### 1. Code and independent variable calculation

In designing central composite rotatable experimentation with 3 independent variables. The codes $-\alpha$, -1, 0, +1 and $+\alpha$ will be used. $\alpha$ code will calculated from

$$\alpha = 2^{k/4} = 2^{3/4} = 1.682$$

the code derived from experimentation will be changed to quantity value of chemicals varied in quantity in different levels according to designed code, calculated from equation (2-32)

$$x = \frac{X - X_0}{t} \qquad (2\text{-}32)$$

For example, in experimentation of varying quantity of antioxidant between 0.0204 - 0.08% with center point ($X_0$) = 0.0502% and having limits in quantity varying (t) 0.0298%. Therefore the code (x) at -1.682 will be using the quantity of antioxidant of

$$X = (-1.682)(0.0298) + 0.0502 = 0.000\%$$

In the same way, the quantity of chosen chemicals that varied can be calculated that is antioxidants and optical brightening agent with different codes by the same method.

## 2. Estimation of multiple linear regression coefficients

The study of response surface methodology of response color index of polymer will be carried out by creating mathematical model with 2nd order polynomial equation as equation (2.4) below

$$y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_{11}x_1^2 + b_{22}x_2^2 + b_{33}x_3^2 + b_{12}x_1x_2 + b_{13}x_1x_3 + b_{23}x_2x_3 \quad ...(C\text{-}1)$$

The estimation of coefficient of above equation can be done by using multiple linear regression analysis by matrix calculation as follows.

From the result of responses color index of several plastic formulas can be written in matrix as shown in Table 4.1

$$X = \begin{array}{c} \begin{matrix} x_0 & x_1 & x_2 & x_3 & x_1^2 & x_2^2 & x_3^2 & x_1x_2 & x_1x_3 & x_2x_3 \end{matrix} \\ \begin{bmatrix} 1 & -1 & -1 & -1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 & 1 & 1 & 1 & -1 & -1 & 1 \\ 1 & -1 & 1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 \\ 1 & 1 & 1 & -1 & 1 & 1 & 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 & 1 & 1 & 1 & 1 & -1 & -1 \\ 1 & 1 & -1 & 1 & 1 & 1 & 1 & -1 & 1 & -1 \\ 1 & -1 & 1 & 1 & 1 & 1 & 1 & -1 & -1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & -1.682 & 0 & 0 & 2.829 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1.682 & 0 & 0 & 2.829 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & -1.682 & 0 & 0 & 2.829 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1.682 & 0 & 0 & 2.829 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & -1.682 & 0 & 0 & 2.829 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1.682 & 0 & 0 & 2.829 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

$$Y = \begin{bmatrix} 82.29 \\ 68.83 \\ 84.40 \\ 67.49 \\ 82.74 \\ 69.86 \\ 86.55 \\ 68.36 \\ 85.94 \\ 64.77 \\ 75.96 \\ 78.57 \\ 74.86 \\ 81.57 \\ 78.40 \\ 78.34 \\ 79.80 \\ 80.07 \\ 78.24 \\ 78.83 \end{bmatrix}$$

Calculating $(X'X)$ and inverse matrix of $(X'X)$ and $(X'Y)$ will get

$$(X'X)=\begin{bmatrix}
20.000 & 0 & 0 & 0 & 13.658 & 13.658 & 16.658 & 0 & 0 & 0 \\
0 & 13.658 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 13.658 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 13.658 & 0 & 0 & 0 & 0 & 0 & 0 \\
13.658 & 0 & 0 & 0 & 24.007 & 8.000 & 8.000 & 0 & 0 & 0 \\
13.658 & 0 & 0 & 0 & 8.000 & 24.007 & 8.000 & 0 & 0 & 0 \\
13.658 & 0 & 0 & 0 & 8.000 & 8.000 & 24.007 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 8.000 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 8.000 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 8.000
\end{bmatrix}$$

$$(X'X)^{-1}=\begin{bmatrix}
0.1663 & 0 & 0 & 0 & -0.057 & -0.057 & -0.057 & 0 & 0 & 0 \\
0 & 0.0732 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0.0732 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0.0732 & 0 & 0 & 0 & 0 & 0 & 0 \\
-0.057 & 0 & 0 & 0 & 0.0694 & 0.0069 & 0.0069 & 0 & 0 & 0 \\
-0.057 & 0 & 0 & 0 & 0.0069 & 0.0694 & 0.0069 & 0 & 0 & 0 \\
-0.057 & 0 & 0 & 0 & 0.0069 & 0.0069 & 0.0694 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.125 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.125 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.125
\end{bmatrix}$$

$$(X'Y)=\begin{bmatrix} 0y \\ 1y \\ 2y \\ 3y \\ 11y \\ 22y \\ 33y \\ 12y \\ 13y \\ 23y \end{bmatrix}=\begin{bmatrix} 154587 \\ -97.0479 \\ 7.47002 \\ 15.78622 \\ 1036792 \\ 1047597 \\ 1052971 \\ -8.76 \\ -0.7 \\ 1.54 \end{bmatrix}$$

Therefore, multiple linear regression coefficients can be estimated from

$$b=(X'X)^{-1}(X'Y)=\begin{bmatrix} b_0 \\ b_1 \\ b_2 \\ b_3 \\ b_{11} \\ b_{22} \\ b_{33} \\ b_{12} \\ b_{13} \\ b_{23} \end{bmatrix}=\begin{bmatrix} 78963 \\ -7.106 \\ 0.547 \\ 1.156 \\ -1.377 \\ -0.702 \\ -0.366 \\ -1.095 \\ -0.088 \\ 0.193 \end{bmatrix}$$

Therefore, response surface equation can be written in 2nd order polynomial equation showing relationship between color index and the code showing quantity of antioxidants and optical brightening agent as the equation below

$$Y = 78.963 - 7.106x_1 + 0.547x_2 + 1.156x_3 - 1.377x_1^2 - 0.702x_2^2 - 0.366x_3^2 - 1.095x_1x_2 - 0.088x_1x_3 + 0.193x_2x_3 \quad \text{...(C-2)}$$

For other responses of polymer, regression analysis method can be used to estimate coefficient of response surface equation too.

## 3. Analysis of Variance

3.1 Total sum of square of responses y calculated from equation (2-52)

$$SS_T = \sum_{i=1}^{n} y_i^2 - \frac{G^2}{n}$$

$$= (82.29^2 + 68.83^2 + ... + 78.24^2 + 78.83^2) - \frac{(82.29 + 68.83 + ... + 78.24 + 78.83)^2}{20}$$

$$= 772.404$$

3.2 Regression sum of square calculated from equation (2-54)

$$SS_R = b'X'Y - \frac{G^2}{n} \qquad ...(2\text{-}54)$$

หรือ $SS_R = SS_{R1} + SS_{R2}$ ...(C-3)

a. First order term of regression sum of square calculated from equation (2-55)

$$SS_{R1} = \sum_{i=1}^{k} b_i (iy)$$

$$= (-7.1054)(-97.048) + (0.5469)(7.47) + (1.1558)(15.786)$$

$$= 711.907$$

and mean square of coefficient of 1st order term of regression is

$$MS_1 = \frac{SS_{R1}}{k} = \frac{711.907}{3} = 237.302$$

b. Second order terms of regression sum of square calculate from equation (2-56)

$$SS_{R2} = b_0 (0y) + \sum_{i=1}^{k} \sum_{j=1}^{k} b_{ij} (ijy) - \frac{G^2}{n}$$

$$= (78.962)(1545.9) + [(-1.377)(1036.8) + (-0.702)(1047.6) + \ldots$$
$$+(0.1925)(1.54)] - 119485703$$
$$= 42.397$$

and mean square of coefficient at second order terms of regression is

$$MS_2 = \frac{SS_{R2}}{\frac{k(k+1)}{2}} = \frac{42.397}{6} = 7.066$$

Therefore regression sum of square can be calculated from equation (C-3) as follow

$$SS_R = 711.907 + 42.397 = 754.303$$

and mean square of coefficient of regression is

$$MS_R = \frac{SS_R}{\frac{k(k+3)}{2}} = \frac{754.303}{9} = 83.811$$

3.3 Error sum of square calculated from equation (2-58) by replacing information from table 5-3, the result is followed

$$SS_E = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$
$$= (82.29 - 80.96)^2 + (68.83 - 69.11)^2 + (84.40 - 83.86)^2 + \ldots + (78.83 - 78.98)^2$$
$$= 18.101$$

and $MS_E$ is

$$MS_E = \frac{SS_E}{n-1-\frac{k(k+3)}{2}} = \frac{18.101}{10} = 1.810$$

Pure error sum of square calculated from equation (2-61) is

$$SS_{PE} = \sum_{u=1}^{n} (y_{1u} - \bar{y}_1)^2$$

By $\bar{y}$ is the average of center response equals

$$\bar{y} = \frac{78.40 + 78.34 + 79.80 + 80.07 + 78.24 + 78.83}{6} = 78.95$$

Then

$$SS_{PE} = (78.40 - 78.95)^2 + (78.34 - 78.95)^2 + ... + (78.83 - 78.95)^2$$
$$= 3.170$$

and $MS_{PE}$

$$MS_{PE} = \frac{SS_{PE}}{n_1 - 1} = \frac{3.170}{6-1} = 0.634$$

Therefore

$$SS_{LOF} = SS_E - SS_{PE} = 18.101 - 3.170 = 14.931$$

and

$$MS_{LOF} = \frac{SS_{LOF}}{n_2 - \frac{k(k+3)}{2}} = 2.986$$

## 4. Calculation of statistic value of $F_0$

4.1 Statistic value $F_0$ of regression analysis calculated from equation (2-64) is

$$F_0 = \frac{MS_R}{MS_E} = \frac{83.811}{7.066} = 46.30$$

As for the statistic value $F_0$ of $SS_{R1}$ and $SS_{R2}$ can be calculated by the same method

4.2 Statistic $F_0$ of error is calculated from equation (2-65)

$$F_0 = \frac{MS_{LOF}}{MS_{PE}} = \frac{2.986}{0.634} = 4.71$$

## 5. Calculation of statistic value $t_0$

Statistic value $t_0$ of each regression coefficient calculated from equation (2-68)

$$t_0 = \frac{b_i}{\sqrt{MS_E C_{ii}}}$$

When $b_i$ = coefficient i

$MS_E$ = Mean square of error

$C_{ii}$ = matrix $(XX)^{-1}$ of i row and i column

For example, statistic value $t_0$ of $b_3$ coefficient in response surface equation of color index equals to

$$t_0 = \frac{1.156}{\sqrt{(1.810)(0.0732)}} = 3.176$$

For statistic value $t_0$ of each $b_i$ coefficient in response surface equation can be calculated by the same method

## 6. Coefficient of determination

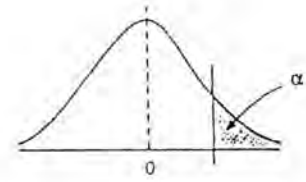
Coefficient of determination of regression analysis of color index calculated from equation (2-69) will derive

$$R^2 = 1 - \frac{SS_E}{SS_T} = 1 - \frac{18.101}{772.404} = 0.9766$$

# APPENDIX D

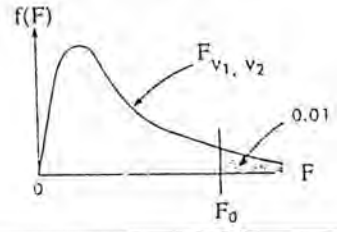
## TABLE OF STATISTICAL t AND f DISTRIBUTION

Table D.1 : The critical value of t-distribution.



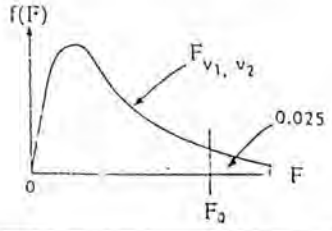

| ν \ α | .40 | .25 | .10 | .05 | .025 | .01 | .005 | .0025 | .001 | .0005 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .325 | 1.000 | 3.078 | 6.314 | 12.706 | 31.821 | 63.657 | 127.32 | 318.31 | 636.62 |
| 2 | .289 | .816 | 1.886 | 2.920 | 4.303 | 6.965 | 9.925 | 14.089 | 23.326 | 31.598 |
| 3 | .277 | .765 | 1.638 | 2.353 | 3.182 | 4.541 | 5.841 | 7.453 | 10.213 | 12.924 |
| 4 | .271 | .741 | 1.533 | 2.132 | 2.776 | 3.747 | 4.604 | 5.598 | 7.173 | 8.610 |
| 5 | .267 | .727 | 1.476 | 2.015 | 2.571 | 3.365 | 4.032 | 4.773 | 5.893 | 6.869 |
| 6 | .265 | .718 | 1.440 | 1.943 | 2.447 | 3.143 | 3.707 | 4.317 | 5.208 | 5.959 |
| 7 | .263 | .711 | 1.415 | 1.895 | 2.365 | 2.998 | 3.499 | 4.029 | 4.785 | 5.408 |
| 8 | .262 | .706 | 1.397 | 1.860 | 2.306 | 2.896 | 3.355 | 3.833 | 4.501 | 5.041 |
| 9 | .261 | .703 | 1.383 | 1.833 | 2.262 | 2.821 | 3.250 | 3.690 | 4.297 | 4.781 |
| 10 | .260 | .700 | 1.372 | 1.812 | 2.228 | 2.764 | 3.169 | 3.581 | 4.144 | 4.587 |
| 11 | .260 | .697 | 1.363 | 1.796 | 2.201 | 2.718 | 3.106 | 3.497 | 4.025 | 4.437 |
| 12 | .259 | .695 | 1.356 | 1.782 | 2.179 | 2.681 | 3.055 | 3.428 | 3.930 | 4.318 |
| 13 | .259 | .694 | 1.350 | 1.771 | 2.160 | 2.650 | 3.012 | 3.372 | 3.852 | 4.221 |
| 14 | .258 | .692 | 1.345 | 1.761 | 2.145 | 2.624 | 2.977 | 3.326 | 3.787 | 4.140 |
| 15 | .258 | .691 | 1.341 | 1.753 | 2.131 | 2.602 | 2.947 | 3.286 | 3.733 | 4.073 |
| 16 | .258 | .690 | 1.337 | 1.746 | 2.210 | 2.583 | 2.921 | 3.252 | 3.686 | 4.015 |
| 17 | .257 | .689 | 1.333 | 1.740 | 2.110 | 2.567 | 2.898 | 3.222 | 3.646 | 3.965 |
| 18 | .257 | .688 | 1.330 | 1.734 | 2.101 | 2.552 | 2.878 | 3.197 | 3.610 | 3.922 |
| 19 | .257 | .688 | 1.328 | 1.729 | 2.093 | 2.539 | 2.861 | 3.174 | 3.579 | 3.883 |
| 20 | .257 | .687 | 1.325 | 1.725 | 2.086 | 2.528 | 2.845 | 3.153 | 3.552 | 3.850 |
| 21 | .257 | .686 | 1.323 | 1.721 | 2.080 | 2.518 | 2.831 | 3.135 | 3.527 | 3.819 |
| 22 | .256 | .686 | 1.321 | 1.717 | 2.074 | 2.508 | 2.819 | 3.119 | 3.505 | 3.792 |
| 23 | .256 | .685 | 1.319 | 1.714 | 2.069 | 2.500 | 2.807 | 3.104 | 3.485 | 3.767 |
| 24 | .256 | .685 | 1.318 | 1.711 | 2.064 | 2.492 | 2.797 | 3.091 | 3.467 | 3.745 |
| 25 | .256 | .684 | 1.316 | 1.708 | 2.060 | 2.485 | 2.787 | 3.078 | 3.450 | 3.725 |
| 26 | .256 | .684 | 1.315 | 1.706 | 2.056 | 2.479 | 2.779 | 3.067 | 3.435 | 3.707 |
| 27 | .256 | .684 | 1.314 | 1.703 | 2.052 | 2.473 | 2.771 | 3.057 | 3.421 | 3.690 |
| 28 | .256 | .683 | 1.313 | 1.701 | 2.048 | 2.467 | 2.763 | 3.047 | 3.408 | 3.674 |
| 29 | .256 | .683 | 1.311 | 1.699 | 2.045 | 2.462 | 2.756 | 3.038 | 3.396 | 3.659 |
| 30 | .256 | .683 | 1.310 | 1.697 | 2.042 | 2.457 | 2.750 | 3.030 | 3.385 | 3.646 |
| 40 | .255 | .681 | 1.303 | 1.684 | 2.021 | 2.423 | 2.704 | 2.971 | 3.307 | 3.551 |
| 60 | .254 | .679 | 1.296 | 1.671 | 2.000 | 2.390 | 2.660 | 2.915 | 3.232 | 3.460 |
| 120 | .254 | .677 | 1.289 | 1.658 | 1.980 | 2.358 | 2.617 | 2.860 | 3.160 | 3.373 |
| ∞ | .253 | .674 | 1.282 | 1.645 | 1.960 | 2.326 | 2.576 | 2.807 | 3.090 | 3.291 |

**Table D.2** : The critical value of F-distribution at the level of significant of 0.01.



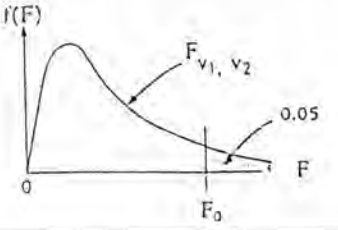

| $v_2$ \ $v_1$ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 15 | 20 | 24 | 30 | 40 | 60 | 120 | ∞ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4052 | 4999.5 | 5403 | 5625 | 5764 | 5859 | 5928 | 5982 | 6022 | 6056 | 6106 | 6157 | 6209 | 6235 | 6261 | 6287 | 6313 | 6339 | 6366 |
| 2 | 98.50 | 99.00 | 99.17 | 99.25 | 99.30 | 99.33 | 99.36 | 99.37 | 99.39 | 99.40 | 99.42 | 99.43 | 99.45 | 99.46 | 99.47 | 99.47 | 99.48 | 99.49 | 99.50 |
| 3 | 34.12 | 30.82 | 29.46 | 28.71 | 28.24 | 27.91 | 27.67 | 27.49 | 27.35 | 27.23 | 27.05 | 26.87 | 26.69 | 26.60 | 26.50 | 26.41 | 26.32 | 26.22 | 26.13 |
| 4 | 21.20 | 18.00 | 16.69 | 15.98 | 15.52 | 15.21 | 14.98 | 14.80 | 14.66 | 14.55 | 14.37 | 14.20 | 14.02 | 13.93 | 13.84 | 13.75 | 13.65 | 13.56 | 13.46 |
| 5 | 16.26 | 13.27 | 12.06 | 11.39 | 10.97 | 10.67 | 10.46 | 10.29 | 10.16 | 10.05 | 9.89 | 9.72 | 9.55 | 9.47 | 9.38 | 9.29 | 9.20 | 9.11 | 9.02 |
| 6 | 13.75 | 10.92 | 9.78 | 9.15 | 8.75 | 8.47 | 8.26 | 8.10 | 7.98 | 7.87 | 7.72 | 7.56 | 7.40 | 7.31 | 7.23 | 7.14 | 7.06 | 6.97 | 6.88 |
| 7 | 12.25 | 9.55 | 8.45 | 7.85 | 7.46 | 7.19 | 6.99 | 6.84 | 6.72 | 6.62 | 6.47 | 6.31 | 6.16 | 6.07 | 5.99 | 5.91 | 5.82 | 5.74 | 5.65 |
| 8 | 11.26 | 8.65 | 7.59 | 7.01 | 6.63 | 6.37 | 6.18 | 6.03 | 5.91 | 5.81 | 5.67 | 5.52 | 5.36 | 5.28 | 5.20 | 5.12 | 5.03 | 4.95 | 4.86 |
| 9 | 10.56 | 8.02 | 6.99 | 6.42 | 6.06 | 5.80 | 5.61 | 5.47 | 5.35 | 5.26 | 5.11 | 4.96 | 4.81 | 4.73 | 4.65 | 4.57 | 4.48 | 4.40 | 4.31 |
| 10 | 10.04 | 7.56 | 6.55 | 5.99 | 5.64 | 5.39 | 5.20 | 5.06 | 4.94 | 4.85 | 4.71 | 4.56 | 4.41 | 4.33 | 4.25 | 4.17 | 4.08 | 4.00 | 3.91 |
| 11 | 9.65 | 7.21 | 6.22 | 5.67 | 5.32 | 5.07 | 4.89 | 4.74 | 4.63 | 4.54 | 4.40 | 4.25 | 4.10 | 4.02 | 3.94 | 3.86 | 3.78 | 3.69 | 3.60 |
| 12 | 9.33 | 6.98 | 5.95 | 5.41 | 5.06 | 4.82 | 4.64 | 4.50 | 4.39 | 4.30 | 4.16 | 4.01 | 3.86 | 3.78 | 3.70 | 3.62 | 3.54 | 3.45 | 3.36 |
| 13 | 9.07 | 6.70 | 5.74 | 5.21 | 4.86 | 4.62 | 4.44 | 4.30 | 4.19 | 4.10 | 3.96 | 3.82 | 3.66 | 3.59 | 3.51 | 3.43 | 3.34 | 3.25 | 3.17 |
| 14 | 8.86 | 6.51 | 5.56 | 5.04 | 4.69 | 4.46 | 4.28 | 4.14 | 4.03 | 3.94 | 3.80 | 3.66 | 3.51 | 3.43 | 3.35 | 3.27 | 3.18 | 3.09 | 3.00 |
| 15 | 8.68 | 6.36 | 5.42 | 4.89 | 4.56 | 4.32 | 4.14 | 4.00 | 3.89 | 3.80 | 3.67 | 3.52 | 3.37 | 3.29 | 3.21 | 3.13 | 3.05 | 2.96 | 2.87 |
| 16 | 8.53 | 6.23 | 5.29 | 4.77 | 4.44 | 4.20 | 4.03 | 3.89 | 3.78 | 3.69 | 3.55 | 3.41 | 3.26 | 3.18 | 3.10 | 3.02 | 2.93 | 2.84 | 2.75 |
| 17 | 8.40 | 6.11 | 5.18 | 4.67 | 4.34 | 4.10 | 3.93 | 3.79 | 3.68 | 3.59 | 3.46 | 3.31 | 3.16 | 3.08 | 3.00 | 2.92 | 2.83 | 2.75 | 2.65 |
| 18 | 8.29 | 6.01 | 5.09 | 4.58 | 4.25 | 4.01 | 3.84 | 3.71 | 3.60 | 3.51 | 3.37 | 3.23 | 3.08 | 3.00 | 2.92 | 2.84 | 2.75 | 2.66 | 2.57 |
| 19 | 8.18 | 5.93 | 5.01 | 4.50 | 4.17 | 3.94 | 3.77 | 3.63 | 3.52 | 3.43 | 3.30 | 3.15 | 3.00 | 2.92 | 2.84 | 2.76 | 2.67 | 2.58 | 2.49 |
| 20 | 8.10 | 5.85 | 4.94 | 4.43 | 4.10 | 3.87 | 3.70 | 3.56 | 3.46 | 3.37 | 3.23 | 3.09 | 2.94 | 2.86 | 2.78 | 2.69 | 2.61 | 2.52 | 2.42 |
| 21 | 8.02 | 5.78 | 4.87 | 4.37 | 4.04 | 3.81 | 3.64 | 3.51 | 3.40 | 3.31 | 3.17 | 3.03 | 2.88 | 2.80 | 2.72 | 2.64 | 2.55 | 2.46 | 2.36 |
| 22 | 7.95 | 5.72 | 4.82 | 4.31 | 3.99 | 3.76 | 3.59 | 3.45 | 3.35 | 3.26 | 3.12 | 2.98 | 2.83 | 2.75 | 2.67 | 2.58 | 2.50 | 2.40 | 2.31 |
| 23 | 7.88 | 5.66 | 4.76 | 4.26 | 3.94 | 3.71 | 3.54 | 3.41 | 3.30 | 3.21 | 3.07 | 2.93 | 2.78 | 2.70 | 2.62 | 2.54 | 2.45 | 2.35 | 2.26 |
| 24 | 7.82 | 5.61 | 4.72 | 4.22 | 3.90 | 3.67 | 3.50 | 3.36 | 3.26 | 3.17 | 3.03 | 2.89 | 2.74 | 2.66 | 2.58 | 2.49 | 2.40 | 2.31 | 2.21 |
| 25 | 7.77 | 5.57 | 4.68 | 4.18 | 3.85 | 3.63 | 3.46 | 3.32 | 3.22 | 3.13 | 2.99 | 2.85 | 2.70 | 2.62 | 2.54 | 2.45 | 2.36 | 2.27 | 2.17 |
| 26 | 7.72 | 5.53 | 4.64 | 4.14 | 3.82 | 3.59 | 3.42 | 3.29 | 3.18 | 3.09 | 2.96 | 2.81 | 2.66 | 2.58 | 2.50 | 2.42 | 2.33 | 2.23 | 2.13 |
| 27 | 7.68 | 5.49 | 4.60 | 4.11 | 3.78 | 3.56 | 3.39 | 3.26 | 3.15 | 3.06 | 2.93 | 2.78 | 2.63 | 2.55 | 2.47 | 2.38 | 2.29 | 2.20 | 2.10 |
| 28 | 7.64 | 5.45 | 4.57 | 4.07 | 3.75 | 3.53 | 3.36 | 3.23 | 3.12 | 3.03 | 2.90 | 2.75 | 2.60 | 2.52 | 2.44 | 2.35 | 2.26 | 2.17 | 2.06 |
| 29 | 7.60 | 5.42 | 4.54 | 4.04 | 3.73 | 3.50 | 3.33 | 3.20 | 3.09 | 3.00 | 2.87 | 2.73 | 2.57 | 2.49 | 2.41 | 2.33 | 2.23 | 2.14 | 2.03 |
| 30 | 7.56 | 5.39 | 4.51 | 4.02 | 3.70 | 3.47 | 3.30 | 3.17 | 3.07 | 2.98 | 2.84 | 2.70 | 2.55 | 2.47 | 2.39 | 2.30 | 2.21 | 2.11 | 2.01 |
| 40 | 7.31 | 5.18 | 4.31 | 3.83 | 3.51 | 3.29 | 3.12 | 2.99 | 2.89 | 2.80 | 2.66 | 2.52 | 2.37 | 2.29 | 2.20 | 2.11 | 2.02 | 1.92 | 1.80 |
| 60 | 7.08 | 4.98 | 4.13 | 3.65 | 3.34 | 3.12 | 2.95 | 2.82 | 2.72 | 2.63 | 2.50 | 2.35 | 2.20 | 2.12 | 2.03 | 1.94 | 1.84 | 1.73 | 1.60 |
| 120 | 6.85 | 4.79 | 3.95 | 3.48 | 3.17 | 2.96 | 2.79 | 2.66 | 2.56 | 2.47 | 2.34 | 2.19 | 2.03 | 1.95 | 1.86 | 1.76 | 1.66 | 1.53 | 1.38 |
| ∞ | 6.63 | 4.61 | 3.78 | 3.32 | 3.02 | 2.80 | 2.64 | 2.51 | 2.41 | 2.32 | 2.18 | 2.04 | 1.88 | 1.79 | 1.70 | 1.59 | 1.47 | 1.32 | 1.00 |

**Table D.3** : The critical value of F-distribution at the level of significant of 0.025.



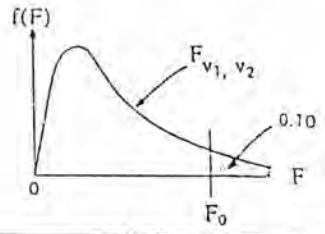

| $v_2$ \ $v_1$ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 15 | 20 | 24 | 30 | 40 | 60 | 120 | ∞ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 647.8 | 799.5 | 864.2 | 899.6 | 921.8 | 937.1 | 948.2 | 956.7 | 963.3 | 968.6 | 976.7 | 984.9 | 993.1 | 997.2 | 1001 | 1006 | 1010 | 1014 | 1018 |
| 2 | 38.51 | 39.00 | 39.17 | 39.25 | 39.30 | 39.33 | 39.36 | 39.37 | 39.39 | 39.40 | 39.41 | 39.43 | 39.45 | 39.46 | 39.46 | 39.47 | 39.48 | 39.49 | 39.50 |
| 3 | 17.44 | 16.04 | 15.44 | 15.10 | 14.88 | 14.73 | 14.62 | 14.54 | 14.47 | 14.42 | 14.34 | 14.25 | 14.17 | 14.12 | 14.08 | 14.04 | 13.99 | 13.95 | 13.90 |
| 4 | 12.22 | 10.65 | 9.98 | 9.60 | 9.36 | 9.20 | 9.07 | 8.98 | 8.90 | 8.84 | 8.75 | 8.66 | 8.56 | 8.51 | 8.46 | 8.41 | 8.36 | 8.31 | 8.26 |
| 5 | 10.01 | 8.43 | 7.76 | 7.39 | 7.15 | 6.98 | 6.85 | 6.76 | 6.68 | 6.62 | 6.52 | 6.43 | 6.33 | 6.28 | 6.23 | 6.18 | 6.12 | 6.07 | 6.02 |
| 6 | 8.81 | 7.26 | 6.60 | 6.23 | 5.99 | 5.82 | 5.70 | 5.60 | 5.52 | 5.46 | 5.37 | 5.27 | 5.17 | 5.12 | 5.07 | 5.01 | 4.96 | 4.90 | 4.85 |
| 7 | 8.07 | 6.54 | 5.89 | 5.52 | 5.29 | 5.12 | 4.99 | 4.90 | 4.82 | 4.76 | 4.67 | 4.57 | 4.47 | 4.42 | 4.36 | 4.31 | 4.25 | 4.20 | 4.14 |
| 8 | 7.57 | 6.06 | 5.42 | 5.05 | 4.82 | 4.65 | 4.53 | 4.43 | 4.36 | 4.30 | 4.20 | 4.10 | 4.00 | 3.95 | 3.89 | 3.84 | 3.78 | 3.73 | 3.67 |
| 9 | 7.21 | 5.71 | 5.08 | 4.72 | 4.48 | 4.32 | 4.20 | 4.10 | 4.03 | 3.96 | 3.87 | 3.77 | 3.67 | 3.61 | 3.56 | 3.51 | 3.45 | 3.39 | 3.33 |
| 10 | 6.94 | 5.46 | 4.83 | 4.47 | 4.24 | 4.07 | 3.95 | 3.85 | 3.78 | 3.72 | 3.62 | 3.52 | 3.42 | 3.37 | 3.31 | 3.26 | 3.20 | 3.14 | 3.08 |
| 11 | 6.72 | 5.26 | 4.63 | 4.28 | 4.04 | 3.88 | 3.76 | 3.66 | 3.59 | 3.53 | 3.43 | 3.33 | 3.23 | 3.17 | 3.12 | 3.06 | 3.00 | 2.94 | 2.88 |
| 12 | 6.55 | 5.10 | 4.47 | 4.12 | 3.89 | 3.73 | 3.61 | 3.51 | 3.44 | 3.37 | 3.28 | 3.18 | 3.07 | 3.02 | 2.96 | 2.91 | 2.85 | 2.79 | 2.72 |
| 13 | 6.41 | 4.97 | 4.35 | 4.00 | 3.77 | 3.60 | 3.48 | 3.39 | 3.31 | 3.25 | 3.15 | 3.05 | 2.95 | 2.89 | 2.84 | 2.78 | 2.72 | 2.66 | 2.60 |
| 14 | 6.30 | 4.86 | 4.24 | 3.89 | 3.66 | 3.50 | 3.38 | 3.29 | 3.21 | 3.15 | 3.05 | 2.95 | 2.84 | 2.79 | 2.73 | 2.67 | 2.61 | 2.55 | 2.49 |
| 15 | 6.20 | 4.77 | 4.15 | 3.80 | 3.58 | 3.41 | 3.29 | 3.20 | 3.12 | 3.06 | 2.96 | 2.86 | 2.76 | 2.70 | 2.64 | 2.59 | 2.52 | 2.46 | 2.40 |
| 16 | 6.12 | 4.69 | 4.08 | 3.73 | 3.50 | 3.34 | 3.22 | 3.12 | 3.05 | 2.99 | 2.89 | 2.79 | 2.68 | 2.63 | 2.57 | 2.51 | 2.45 | 2.38 | 2.32 |
| 17 | 6.04 | 4.62 | 4.01 | 3.66 | 3.44 | 3.28 | 3.16 | 3.06 | 2.98 | 2.92 | 2.82 | 2.72 | 2.62 | 2.56 | 2.50 | 2.44 | 2.38 | 2.32 | 2.25 |
| 18 | 5.98 | 4.56 | 3.95 | 3.61 | 3.38 | 3.22 | 3.10 | 3.01 | 2.93 | 2.87 | 2.77 | 2.67 | 2.56 | 2.50 | 2.44 | 2.38 | 2.32 | 2.26 | 2.19 |
| 19 | 5.92 | 4.51 | 3.90 | 3.56 | 3.33 | 3.17 | 3.05 | 2.96 | 2.88 | 2.82 | 2.72 | 2.62 | 2.51 | 2.45 | 2.39 | 2.33 | 2.27 | 2.20 | 2.13 |
| 20 | 5.87 | 4.46 | 3.86 | 3.51 | 3.29 | 3.13 | 3.01 | 2.91 | 2.84 | 2.77 | 2.68 | 2.57 | 2.46 | 2.41 | 2.35 | 2.29 | 2.22 | 2.16 | 2.09 |
| 21 | 5.83 | 4.42 | 3.82 | 3.48 | 3.25 | 3.09 | 2.97 | 2.87 | 2.80 | 2.73 | 2.64 | 2.53 | 2.42 | 2.37 | 2.31 | 2.25 | 2.18 | 2.11 | 2.04 |
| 22 | 5.79 | 4.38 | 3.78 | 3.44 | 3.22 | 3.05 | 2.93 | 2.84 | 2.76 | 2.70 | 2.60 | 2.50 | 2.39 | 2.33 | 2.27 | 2.21 | 2.14 | 2.08 | 2.00 |
| 23 | 5.75 | 4.35 | 3.75 | 3.41 | 3.18 | 3.02 | 2.90 | 2.81 | 2.73 | 2.67 | 2.57 | 2.47 | 2.36 | 2.30 | 2.24 | 2.18 | 2.11 | 2.04 | 1.97 |
| 24 | 5.72 | 4.32 | 3.72 | 3.38 | 3.15 | 2.99 | 2.87 | 2.78 | 2.70 | 2.64 | 2.54 | 2.44 | 2.33 | 2.27 | 2.21 | 2.15 | 2.08 | 2.01 | 1.94 |
| 25 | 5.69 | 4.29 | 3.69 | 3.35 | 3.13 | 2.97 | 2.85 | 2.75 | 2.68 | 2.61 | 2.51 | 2.41 | 2.30 | 2.24 | 2.18 | 2.12 | 2.05 | 1.98 | 1.91 |
| 26 | 5.66 | 4.27 | 3.67 | 3.33 | 3.10 | 2.94 | 2.82 | 2.73 | 2.65 | 2.59 | 2.49 | 2.39 | 2.28 | 2.22 | 2.16 | 2.09 | 2.03 | 1.95 | 1.88 |
| 27 | 5.63 | 4.24 | 3.65 | 3.31 | 3.08 | 2.92 | 2.80 | 2.71 | 2.63 | 2.57 | 2.47 | 2.36 | 2.25 | 2.19 | 2.13 | 2.07 | 2.00 | 1.93 | 1.85 |
| 28 | 5.61 | 4.22 | 3.63 | 3.29 | 3.06 | 2.90 | 2.78 | 2.69 | 2.61 | 2.55 | 2.45 | 2.34 | 2.23 | 2.17 | 2.11 | 2.05 | 1.98 | 1.91 | 1.83 |
| 29 | 5.59 | 4.20 | 3.61 | 3.27 | 3.04 | 2.88 | 2.76 | 2.67 | 2.59 | 2.53 | 2.43 | 2.32 | 2.21 | 2.15 | 2.09 | 2.03 | 1.96 | 1.89 | 1.81 |
| 30 | 5.57 | 4.18 | 3.59 | 3.25 | 3.03 | 2.87 | 2.75 | 2.65 | 2.57 | 2.51 | 2.41 | 2.31 | 2.20 | 2.14 | 2.07 | 2.01 | 1.94 | 1.87 | 1.79 |
| 40 | 5.42 | 4.05 | 3.46 | 3.13 | 2.90 | 2.74 | 2.62 | 2.53 | 2.45 | 2.39 | 2.29 | 2.18 | 2.07 | 2.01 | 1.94 | 1.88 | 1.80 | 1.72 | 1.64 |
| 60 | 5.29 | 3.93 | 3.34 | 3.01 | 2.79 | 2.63 | 2.51 | 2.41 | 2.33 | 2.27 | 2.17 | 2.06 | 1.94 | 1.88 | 1.82 | 1.74 | 1.67 | 1.58 | 1.48 |
| 120 | 5.15 | 3.80 | 3.23 | 2.89 | 2.67 | 2.52 | 2.39 | 2.30 | 2.22 | 2.16 | 2.05 | 1.94 | 1.82 | 1.76 | 1.69 | 1.61 | 1.53 | 1.43 | 1.31 |
| ∞ | 5.02 | 3.69 | 3.12 | 2.79 | 2.57 | 2.41 | 2.29 | 2.19 | 2.11 | 2.05 | 1.94 | 1.83 | 1.71 | 1.64 | 1.57 | 1.48 | 1.39 | 1.27 | 1.00 |

**Table D.4** : The critical value of F-distribution at the level of significant of 0.05.



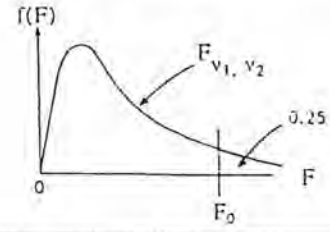

| $v_2$ \ $v_1$ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 15 | 20 | 24 | 30 | 40 | 60 | 120 | ∞ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 161.4 | 199.5 | 215.7 | 224.6 | 230.2 | 234.0 | 236.8 | 238.9 | 240.5 | 241.9 | 243.9 | 245.9 | 248.0 | 249.1 | 250.1 | 251.1 | 252.2 | 253.3 | 254.3 |
| 2 | 18.51 | 19.00 | 19.16 | 19.25 | 19.30 | 19.33 | 19.35 | 19.37 | 19.38 | 19.40 | 19.41 | 19.43 | 19.45 | 19.45 | 19.46 | 19.47 | 19.48 | 19.49 | 19.50 |
| 3 | 10.13 | 9.55 | 9.28 | 9.12 | 9.01 | 8.94 | 8.89 | 8.85 | 8.81 | 8.79 | 8.74 | 8.70 | 8.66 | 8.64 | 8.62 | 8.59 | 8.57 | 8.55 | 8.53 |
| 4 | 7.71 | 6.94 | 6.59 | 6.39 | 6.26 | 6.16 | 6.09 | 6.04 | 6.00 | 5.96 | 5.91 | 5.86 | 5.80 | 5.77 | 5.75 | 5.72 | 5.69 | 5.66 | 5.63 |
| 5 | 6.61 | 5.79 | 5.41 | 5.19 | 5.05 | 4.95 | 4.88 | 4.82 | 4.77 | 4.74 | 4.68 | 4.62 | 4.56 | 4.53 | 4.50 | 4.46 | 4.43 | 4.40 | 4.36 |
| 6 | 5.99 | 5.14 | 4.76 | 4.53 | 4.39 | 4.28 | 4.21 | 4.15 | 4.10 | 4.06 | 4.00 | 3.94 | 3.87 | 3.84 | 3.81 | 3.77 | 3.74 | 3.70 | 3.67 |
| 7 | 5.59 | 4.74 | 4.35 | 4.12 | 3.97 | 3.87 | 3.79 | 3.73 | 3.68 | 3.64 | 3.57 | 3.51 | 3.44 | 3.41 | 3.38 | 3.34 | 3.30 | 3.27 | 3.23 |
| 8 | 5.32 | 4.46 | 4.07 | 3.84 | 3.69 | 3.58 | 3.50 | 3.44 | 3.39 | 3.35 | 3.28 | 3.22 | 3.15 | 3.12 | 3.08 | 3.04 | 3.01 | 2.97 | 2.93 |
| 9 | 5.12 | 4.26 | 3.86 | 3.63 | 3.48 | 3.37 | 3.29 | 3.23 | 3.18 | 3.14 | 3.07 | 3.01 | 2.94 | 2.90 | 2.86 | 2.83 | 2.79 | 2.75 | 2.71 |
| 10 | 4.96 | 4.10 | 3.71 | 3.48 | 3.33 | 3.22 | 3.14 | 3.07 | 3.02 | 2.98 | 2.91 | 2.85 | 2.77 | 2.74 | 2.70 | 2.66 | 2.62 | 2.58 | 2.54 |
| 11 | 4.84 | 3.98 | 3.59 | 3.36 | 3.20 | 3.09 | 3.01 | 2.95 | 2.90 | 2.85 | 2.79 | 2.72 | 2.65 | 2.61 | 2.57 | 2.53 | 2.49 | 2.45 | 2.40 |
| 12 | 4.75 | 3.89 | 3.49 | 3.26 | 3.11 | 3.00 | 2.91 | 2.85 | 2.80 | 2.75 | 2.69 | 2.62 | 2.54 | 2.51 | 2.47 | 2.43 | 2.38 | 2.34 | 2.30 |
| 13 | 4.67 | 3.81 | 3.41 | 3.18 | 3.03 | 2.92 | 2.83 | 2.77 | 2.71 | 2.67 | 2.60 | 2.53 | 2.46 | 2.42 | 2.38 | 2.34 | 2.30 | 2.25 | 2.21 |
| 14 | 4.60 | 3.74 | 3.34 | 3.11 | 2.96 | 2.85 | 2.76 | 2.70 | 2.65 | 2.60 | 2.53 | 2.46 | 2.39 | 2.35 | 2.31 | 2.27 | 2.22 | 2.18 | 2.13 |
| 15 | 4.54 | 3.68 | 3.29 | 3.06 | 2.90 | 2.79 | 2.71 | 2.64 | 2.59 | 2.54 | 2.48 | 2.40 | 2.33 | 2.29 | 2.25 | 2.20 | 2.16 | 2.11 | 2.07 |
| 16 | 4.49 | 3.63 | 3.24 | 3.01 | 2.85 | 2.74 | 2.66 | 2.59 | 2.54 | 2.49 | 2.42 | 2.35 | 2.28 | 2.24 | 2.19 | 2.15 | 2.11 | 2.06 | 2.01 |
| 17 | 4.45 | 3.59 | 3.20 | 2.96 | 2.81 | 2.70 | 2.61 | 2.55 | 2.49 | 2.45 | 2.38 | 2.31 | 2.23 | 2.19 | 2.15 | 2.10 | 2.06 | 2.01 | 1.96 |
| 18 | 4.41 | 3.55 | 3.16 | 2.93 | 2.77 | 2.66 | 2.58 | 2.51 | 2.46 | 2.41 | 2.34 | 2.27 | 2.19 | 2.15 | 2.11 | 2.06 | 2.02 | 1.97 | 1.92 |
| 19 | 4.38 | 3.52 | 3.13 | 2.90 | 2.74 | 2.63 | 2.54 | 2.48 | 2.42 | 2.38 | 2.31 | 2.23 | 2.16 | 2.11 | 2.07 | 2.03 | 1.98 | 1.93 | 1.88 |
| 20 | 4.35 | 3.49 | 3.10 | 2.87 | 2.71 | 2.60 | 2.51 | 2.45 | 2.39 | 2.35 | 2.28 | 2.20 | 2.12 | 2.08 | 2.04 | 1.99 | 1.95 | 1.90 | 1.84 |
| 21 | 4.32 | 3.47 | 3.07 | 2.84 | 2.68 | 2.57 | 2.49 | 2.42 | 2.37 | 2.32 | 2.25 | 2.18 | 2.10 | 2.05 | 2.01 | 1.96 | 1.92 | 1.87 | 1.81 |
| 22 | 4.30 | 3.44 | 3.05 | 2.82 | 2.66 | 2.55 | 2.46 | 2.40 | 2.34 | 2.30 | 2.23 | 2.15 | 2.07 | 2.03 | 1.98 | 1.94 | 1.89 | 1.84 | 1.78 |
| 23 | 4.28 | 3.42 | 3.03 | 2.80 | 2.64 | 2.53 | 2.44 | 2.37 | 2.32 | 2.27 | 2.20 | 2.13 | 2.05 | 2.01 | 1.96 | 1.91 | 1.86 | 1.81 | 1.76 |
| 24 | 4.26 | 3.40 | 3.01 | 2.78 | 2.62 | 2.51 | 2.42 | 2.36 | 2.30 | 2.25 | 2.18 | 2.11 | 2.03 | 1.98 | 1.94 | 1.89 | 1.84 | 1.79 | 1.73 |
| 25 | 4.24 | 3.39 | 2.99 | 2.76 | 2.60 | 2.49 | 2.40 | 2.34 | 2.28 | 2.24 | 2.16 | 2.09 | 2.01 | 1.96 | 1.92 | 1.87 | 1.82 | 1.77 | 1.71 |
| 26 | 4.23 | 3.37 | 2.98 | 2.74 | 2.59 | 2.47 | 2.39 | 2.32 | 2.27 | 2.22 | 2.15 | 2.07 | 1.99 | 1.95 | 1.90 | 1.85 | 1.80 | 1.75 | 1.69 |
| 27 | 4.21 | 3.35 | 2.96 | 2.73 | 2.57 | 2.46 | 2.37 | 2.31 | 2.25 | 2.20 | 2.13 | 2.06 | 1.97 | 1.93 | 1.88 | 1.84 | 1.79 | 1.73 | 1.67 |
| 28 | 4.20 | 3.34 | 2.95 | 2.71 | 2.56 | 2.45 | 2.36 | 2.29 | 2.24 | 2.19 | 2.12 | 2.04 | 1.96 | 1.91 | 1.87 | 1.82 | 1.77 | 1.71 | 1.65 |
| 29 | 4.18 | 3.33 | 2.93 | 2.70 | 2.55 | 2.43 | 2.35 | 2.28 | 2.22 | 2.18 | 2.10 | 2.03 | 1.94 | 1.90 | 1.85 | 1.81 | 1.75 | 1.70 | 1.64 |
| 30 | 4.17 | 3.32 | 2.92 | 2.69 | 2.53 | 2.42 | 2.33 | 2.27 | 2.21 | 2.16 | 2.09 | 2.01 | 1.93 | 1.89 | 1.84 | 1.79 | 1.74 | 1.68 | 1.62 |
| 40 | 4.08 | 3.23 | 2.84 | 2.61 | 2.45 | 2.34 | 2.25 | 2.18 | 2.12 | 2.08 | 2.00 | 1.92 | 1.84 | 1.79 | 1.74 | 1.69 | 1.64 | 1.58 | 1.51 |
| 60 | 4.00 | 3.15 | 2.76 | 2.53 | 2.37 | 2.25 | 2.17 | 2.10 | 2.04 | 1.99 | 1.92 | 1.84 | 1.75 | 1.70 | 1.65 | 1.59 | 1.53 | 1.47 | 1.39 |
| 120 | 3.92 | 3.07 | 2.68 | 2.45 | 2.29 | 2.17 | 2.09 | 2.02 | 1.96 | 1.91 | 1.83 | 1.75 | 1.66 | 1.61 | 1.55 | 1.55 | 1.43 | 1.35 | 1.25 |
| ∞ | 3.84 | 3.00 | 2.60 | 2.37 | 2.21 | 2.10 | 2.01 | 1.94 | 1.88 | 1.83 | 1.75 | 1.67 | 1.57 | 1.52 | 1.46 | 1.39 | 1.32 | 1.22 | 1.00 |

**Table D.5 :** The critical value of F-distribution at the level of significant of 0.10.




| $v_2$ \ $v_1$ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 15 | 20 | 24 | 30 | 40 | 60 | 120 | ∞ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 39.86 | 49.50 | 53.59 | 55.83 | 57.24 | 58.20 | 58.91 | 59.44 | 59.86 | 60.19 | 60.71 | 61.22 | 61.74 | 62.00 | 62.26 | 62.53 | 62.79 | 63.06 | 63.33 |
| 2 | 8.53 | 9.00 | 9.16 | 9.24 | 9.29 | 9.33 | 9.35 | 9.37 | 9.38 | 9.39 | 9.41 | 9.42 | 9.44 | 9.45 | 9.46 | 9.47 | 9.47 | 9.48 | 9.49 |
| 3 | 5.54 | 5.46 | 5.39 | 5.34 | 5.31 | 5.28 | 5.27 | 5.25 | 5.24 | 5.23 | 5.22 | 5.20 | 5.18 | 5.18 | 5.17 | 5.16 | 5.15 | 5.14 | 5.13 |
| 4 | 4.54 | 4.32 | 4.19 | 4.11 | 4.05 | 4.01 | 3.98 | 3.95 | 3.94 | 3.92 | 3.90 | 3.87 | 3.84 | 3.83 | 3.82 | 3.80 | 3.79 | 3.78 | 3.76 |
| 5 | 4.06 | 3.78 | 3.62 | 3.52 | 3.45 | 3.40 | 3.37 | 3.34 | 3.32 | 3.30 | 3.27 | 3.24 | 3.21 | 3.19 | 3.17 | 3.16 | 3.14 | 3.12 | 3.10 |
| 6 | 3.78 | 3.46 | 3.29 | 3.18 | 3.11 | 3.05 | 3.01 | 2.98 | 2.96 | 2.94 | 2.90 | 2.87 | 2.84 | 2.82 | 2.80 | 2.78 | 2.76 | 2.74 | 2.72 |
| 7 | 3.59 | 3.26 | 3.07 | 2.96 | 2.88 | 2.83 | 2.78 | 2.75 | 2.72 | 2.70 | 2.67 | 2.63 | 2.59 | 2.58 | 2.56 | 2.54 | 2.51 | 2.49 | 2.47 |
| 8 | 3.46 | 3.11 | 2.92 | 2.81 | 2.73 | 2.67 | 2.62 | 2.59 | 2.56 | 2.54 | 2.50 | 2.46 | 2.42 | 2.40 | 2.38 | 2.36 | 2.34 | 2.32 | 2.29 |
| 9 | 3.36 | 3.01 | 2.81 | 2.69 | 2.61 | 2.55 | 2.51 | 2.47 | 2.44 | 2.42 | 2.38 | 2.34 | 2.30 | 2.28 | 2.25 | 2.23 | 2.21 | 2.18 | 2.16 |
| 10 | 3.29 | 2.92 | 2.73 | 2.61 | 2.52 | 2.46 | 2.41 | 2.38 | 2.35 | 2.32 | 2.28 | 2.24 | 2.20 | 2.18 | 2.16 | 2.13 | 2.11 | 2.08 | 2.06 |
| 11 | 3.23 | 2.86 | 2.66 | 2.54 | 2.45 | 2.39 | 2.34 | 2.30 | 2.27 | 2.25 | 2.21 | 2.17 | 2.12 | 2.10 | 2.08 | 2.05 | 2.03 | 2.00 | 1.97 |
| 12 | 3.18 | 2.81 | 2.61 | 2.48 | 2.39 | 2.33 | 2.28 | 2.24 | 2.21 | 2.19 | 2.15 | 2.10 | 2.06 | 2.04 | 2.01 | 1.99 | 1.96 | 1.93 | 1.90 |
| 13 | 3.14 | 2.76 | 2.56 | 2.43 | 2.35 | 2.28 | 2.23 | 2.20 | 2.16 | 2.14 | 2.10 | 2.05 | 2.01 | 1.98 | 1.96 | 1.93 | 1.90 | 1.88 | 1.85 |
| 14 | 3.10 | 2.73 | 2.52 | 2.39 | 2.31 | 2.24 | 2.19 | 2.15 | 2.12 | 2.10 | 2.05 | 2.01 | 1.96 | 1.94 | 1.91 | 1.89 | 1.86 | 1.83 | 1.80 |
| 15 | 3.07 | 2.70 | 2.49 | 2.36 | 2.27 | 2.21 | 2.16 | 2.12 | 2.09 | 2.06 | 2.02 | 1.97 | 1.92 | 1.90 | 1.87 | 1.85 | 1.82 | 1.79 | 1.76 |
| 16 | 3.05 | 2.67 | 2.46 | 2.33 | 2.24 | 2.18 | 2.13 | 2.09 | 2.06 | 2.03 | 1.99 | 1.94 | 1.89 | 1.87 | 1.84 | 1.81 | 1.78 | 1.75 | 1.72 |
| 17 | 3.03 | 2.64 | 2.44 | 2.31 | 2.22 | 2.15 | 2.10 | 2.06 | 2.03 | 2.00 | 1.96 | 1.91 | 1.86 | 1.84 | 1.81 | 1.78 | 1.75 | 1.72 | 1.69 |
| 18 | 3.01 | 2.62 | 2.42 | 2.29 | 2.20 | 2.13 | 2.08 | 2.04 | 2.00 | 1.98 | 1.93 | 1.89 | 1.84 | 1.81 | 1.78 | 1.75 | 1.72 | 1.69 | 1.66 |
| 19 | 2.99 | 2.61 | 2.40 | 2.27 | 2.18 | 2.11 | 2.06 | 2.02 | 1.98 | 1.96 | 1.91 | 1.86 | 1.81 | 1.79 | 1.76 | 1.73 | 1.70 | 1.67 | 1.63 |
| 20 | 2.97 | 2.59 | 2.38 | 2.25 | 2.16 | 2.09 | 2.04 | 2.00 | 1.96 | 1.94 | 1.89 | 1.84 | 1.79 | 1.77 | 1.74 | 1.71 | 1.68 | 1.64 | 1.61 |
| 21 | 2.96 | 2.57 | 2.36 | 2.23 | 2.14 | 2.08 | 2.02 | 1.98 | 1.95 | 1.92 | 1.87 | 1.83 | 1.78 | 1.75 | 1.72 | 1.69 | 1.66 | 1.62 | 1.59 |
| 22 | 2.95 | 2.56 | 2.35 | 2.22 | 2.13 | 2.06 | 2.01 | 1.97 | 1.93 | 1.90 | 1.86 | 1.81 | 1.76 | 1.73 | 1.70 | 1.67 | 1.64 | 1.60 | 0.57 |
| 23 | 2.94 | 2.55 | 2.34 | 2.21 | 2.11 | 2.05 | 1.99 | 1.95 | 1.92 | 1.89 | 1.84 | 1.80 | 1.74 | 1.72 | 1.69 | 1.66 | 1.62 | 1.59 | 1.55 |
| 24 | 2.93 | 2.54 | 2.33 | 2.19 | 2.10 | 2.04 | 1.98 | 1.94 | 1.91 | 1.88 | 1.83 | 1.78 | 1.73 | 1.70 | 1.67 | 1.64 | 1.61 | 1.57 | 1.53 |
| 25 | 2.92 | 2.53 | 2.32 | 2.18 | 2.09 | 2.02 | 1.97 | 1.93 | 1.89 | 1.87 | 1.82 | 1.77 | 1.72 | 1.69 | 1.66 | 1.63 | 1.59 | 1.56 | 1.52 |
| 26 | 2.91 | 2.52 | 2.31 | 2.17 | 2.08 | 2.01 | 1.76 | 1.92 | 1.88 | 1.86 | 1.81 | 1.76 | 1.71 | 1.68 | 1.65 | 1.61 | 1.58 | 1.54 | 1.50 |
| 27 | 2.90 | 2.51 | 2.30 | 2.17 | 2.07 | 2.00 | 1.95 | 1.91 | 1.87 | 1.85 | 1.80 | 1.75 | 1.70 | 1.67 | 1.64 | 1.60 | 1.57 | 1.53 | 1.49 |
| 28 | 2.89 | 2.50 | 2.29 | 2.16 | 2.06 | 2.00 | 1.94 | 1.90 | 1.87 | 1.84 | 1.79 | 1.74 | 1.69 | 1.66 | 1.63 | 1.59 | 1.56 | 1.52 | 1.48 |
| 29 | 2.89 | 2.50 | 2.28 | 2.15 | 2.06 | 1.99 | 1.93 | 1.89 | 1.86 | 1.83 | 1.78 | 1.73 | 1.68 | 1.65 | 1.62 | 1.58 | 1.55 | 1.51 | 1.47 |
| 30 | 2.88 | 2.49 | 2.28 | 2.14 | 2.03 | 1.98 | 1.93 | 1.88 | 1.85 | 1.82 | 1.77 | 1.72 | 1.67 | 1.64 | 1.61 | 1.57 | 1.54 | 1.50 | 1.46 |
| 40 | 2.84 | 2.44 | 2.23 | 2.09 | 2.00 | 1.93 | 1.87 | 1.83 | 1.79 | 1.76 | 1.71 | 1.66 | 1.61 | 1.57 | 1.54 | 1.51 | 1.47 | 1.42 | 1.38 |
| 60 | 2.79 | 2.39 | 2.18 | 2.04 | 1.95 | 1.87 | 1.82 | 1.77 | 1.74 | 1.71 | 1.66 | 1.60 | 1.54 | 1.51 | 1.48 | 1.44 | 1.40 | 1.35 | 1.29 |
| 120 | 2.75 | 2.35 | 2.13 | 1.99 | 1.90 | 1.82 | 1.77 | 1.72 | 1.68 | 1.65 | 1.60 | 1.55 | 1.48 | 1.45 | 1.41 | 1.37 | 1.32 | 1.26 | 1.19 |
| ∞ | 2.71 | 2.30 | 2.08 | 1.94 | 1.85 | 1.77 | 1.72 | 1.67 | 1.63 | 1.60 | 1.55 | 1.49 | 1.42 | 1.38 | 1.34 | 1.30 | 1.24 | 1.17 | 1.00 |

**Table D.6** : The critical value of F-distribution at the level of significant of 0.25.




| $v_2$ \ $v_1$ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 15 | 20 | 24 | 30 | 40 | 60 | 120 | ∞ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.83 | 7.50 | 8.20 | 8.58 | 8.82 | 8.98 | 9.10 | 9.19 | 9.26 | 9.32 | 9.41 | 9.49 | 9.58 | 9.63 | 9.67 | 9.71 | 9.76 | 9.80 | 9.85 |
| 2 | 2.57 | 3.00 | 3.15 | 3.23 | 3.28 | 3.31 | 3.34 | 3.35 | 3.37 | 3.38 | 3.39 | 3.41 | 3.43 | 3.43 | 3.44 | 3.45 | 3.46 | 3.47 | 3.48 |
| 3 | 2.02 | 2.28 | 2.36 | 2.39 | 2.41 | 2.42 | 2.43 | 2.44 | 2.44 | 2.44 | 2.45 | 2.46 | 2.46 | 2.46 | 2.47 | 2.47 | 2.47 | 2.47 | 2.47 |
| 4 | 1.81 | 2.00 | 2.05 | 2.06 | 2.07 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 |
| 5 | 1.69 | 1.85 | 1.88 | 1.89 | 1.89 | 1.89 | 1.89 | 1.89 | 1.89 | 1.89 | 1.89 | 1.89 | 1.88 | 1.88 | 1.88 | 1.88 | 1.87 | 1.87 | 1.87 |
| 6 | 1.62 | 1.76 | 1.78 | 1.79 | 1.79 | 1.78 | 1.78 | 1.78 | 1.77 | 1.77 | 1.77 | 1.76 | 1.76 | 1.75 | 1.75 | 1.75 | 1.74 | 1.74 | 1.74 |
| 7 | 1.57 | 1.70 | 1.72 | 1.72 | 1.71 | 1.71 | 1.70 | 1.70 | 1.70 | 1.69 | 1.68 | 1.68 | 1.67 | 1.67 | 1.66 | 1.66 | 1.65 | 1.65 | 1.65 |
| 8 | 1.54 | 1.66 | 1.67 | 1.66 | 1.66 | 1.65 | 1.64 | 1.64 | 1.63 | 1.63 | 1.62 | 1.62 | 1.61 | 1.60 | 1.60 | 1.59 | 1.59 | 1.58 | 1.58 |
| 9 | 1.51 | 1.62 | 1.63 | 1.63 | 1.62 | 1.61 | 1.60 | 1.60 | 1.59 | 1.59 | 1.58 | 1.57 | 1.56 | 1.56 | 1.55 | 1.54 | 1.54 | 1.53 | 1.53 |
| 10 | 1.49 | 1.60 | 1.60 | 1.59 | 1.59 | 1.58 | 1.57 | 1.56 | 1.56 | 1.55 | 1.54 | 1.53 | 1.52 | 1.52 | 1.51 | 1.51 | 1.50 | 1.49 | 1.48 |
| 11 | 1.47 | 1.58 | 1.58 | 1.57 | 1.56 | 1.55 | 1.54 | 1.53 | 1.53 | 1.52 | 1.51 | 1.50 | 1.49 | 1.49 | 1.48 | 1.47 | 1.47 | 1.46 | 1.45 |
| 12 | 1.46 | 1.56 | 1.56 | 1.55 | 1.54 | 1.53 | 1.52 | 1.51 | 1.51 | 1.50 | 1.49 | 1.48 | 1.47 | 1.46 | 1.45 | 1.45 | 1.44 | 1.43 | 1.42 |
| 13 | 1.45 | 1.55 | 1.55 | 1.53 | 1.52 | 1.51 | 1.50 | 1.49 | 1.49 | 1.48 | 1.47 | 1.46 | 1.45 | 1.44 | 1.43 | 1.42 | 1.42 | 1.41 | 1.40 |
| 14 | 1.44 | 1.53 | 1.53 | 1.52 | 1.51 | 1.50 | 1.49 | 1.48 | 1.47 | 1.46 | 1.45 | 1.44 | 1.43 | 1.42 | 1.41 | 1.41 | 1.40 | 1.39 | 1.38 |
| 15 | 1.43 | 1.52 | 1.52 | 1.51 | 1.49 | 1.48 | 1.47 | 1.46 | 1.46 | 1.45 | 1.44 | 1.43 | 1.41 | 1.41 | 1.40 | 1.39 | 1.38 | 1.37 | 1.36 |
| 16 | 1.42 | 1.51 | 1.51 | 1.50 | 1.48 | 1.47 | 1.46 | 1.45 | 1.44 | 1.44 | 1.43 | 1.41 | 1.40 | 1.39 | 1.38 | 1.37 | 1.36 | 1.35 | 1.34 |
| 17 | 1.42 | 1.51 | 1.50 | 1.49 | 1.47 | 1.46 | 1.45 | 1.44 | 1.43 | 1.43 | 1.41 | 1.40 | 1.39 | 1.38 | 1.37 | 1.36 | 1.35 | 1.34 | 1.33 |
| 18 | 1.41 | 1.50 | 1.49 | 1.48 | 1.46 | 1.45 | 1.44 | 1.43 | 1.42 | 1.42 | 1.40 | 1.39 | 1.38 | 1.37 | 1.36 | 1.35 | 1.34 | 1.33 | 1.32 |
| 19 | 1.41 | 1.49 | 1.49 | 1.47 | 1.46 | 1.44 | 1.43 | 1.42 | 1.41 | 1.41 | 1.40 | 1.38 | 1.37 | 1.36 | 1.35 | 1.34 | 1.33 | 1.32 | 1.30 |
| 20 | 1.40 | 1.49 | 1.48 | 1.47 | 1.45 | 1.44 | 1.43 | 1.42 | 1.41 | 1.40 | 1.39 | 1.37 | 1.36 | 1.35 | 1.34 | 1.33 | 1.32 | 1.31 | 1.29 |
| 21 | 1.40 | 1.48 | 1.48 | 1.46 | 1.44 | 1.43 | 1.42 | 1.41 | 1.40 | 1.39 | 1.38 | 1.37 | 1.35 | 1.34 | 1.33 | 1.32 | 1.31 | 1.30 | 1.28 |
| 22 | 1.40 | 1.48 | 1.47 | 1.45 | 1.44 | 1.42 | 1.41 | 1.40 | 1.39 | 1.39 | 1.37 | 1.36 | 1.34 | 1.33 | 1.32 | 1.31 | 1.30 | 1.29 | 1.28 |
| 23 | 1.39 | 1.47 | 1.47 | 1.45 | 1.43 | 1.42 | 1.41 | 1.40 | 1.39 | 1.38 | 1.37 | 1.35 | 1.34 | 1.33 | 1.32 | 1.31 | 1.30 | 1.28 | 1.27 |
| 24 | 1.39 | 1.47 | 1.46 | 1.44 | 1.43 | 1.41 | 1.40 | 1.39 | 1.38 | 1.38 | 1.36 | 1.35 | 1.33 | 1.32 | 1.31 | 1.30 | 1.29 | 1.28 | 1.26 |
| 25 | 1.39 | 1.47 | 1.46 | 1.44 | 1.42 | 1.41 | 1.40 | 1.39 | 1.38 | 1.37 | 1.36 | 1.34 | 1.33 | 1.32 | 1.31 | 1.29 | 1.28 | 1.27 | 1.25 |
| 26 | 1.38 | 1.46 | 1.45 | 1.44 | 1.42 | 1.41 | 1.39 | 1.38 | 1.37 | 1.37 | 1.35 | 1.34 | 1.32 | 1.31 | 1.30 | 1.29 | 1.28 | 1.26 | 1.25 |
| 27 | 1.38 | 1.46 | 1.45 | 1.43 | 1.42 | 1.40 | 1.39 | 1.38 | 1.37 | 1.36 | 1.35 | 1.33 | 1.32 | 1.31 | 1.30 | 1.28 | 1.27 | 1.26 | 1.24 |
| 28 | 1.38 | 1.46 | 1.45 | 1.43 | 1.41 | 1.40 | 1.39 | 1.38 | 1.37 | 1.36 | 1.34 | 1.33 | 1.31 | 1.30 | 1.29 | 1.28 | 1.27 | 1.25 | 1.24 |
| 29 | 1.38 | 1.45 | 1.45 | 1.43 | 1.41 | 1.40 | 1.38 | 1.37 | 1.36 | 1.35 | 1.34 | 1.32 | 1.31 | 1.30 | 1.29 | 1.27 | 1.26 | 1.25 | 1.23 |
| 30 | 1.38 | 1.45 | 1.44 | 1.42 | 1.41 | 1.39 | 1.38 | 1.37 | 1.36 | 1.35 | 1.34 | 1.32 | 1.30 | 1.29 | 1.28 | 1.27 | 1.26 | 1.24 | 1.23 |
| 40 | 1.36 | 1.44 | 1.42 | 1.40 | 1.39 | 1.37 | 1.36 | 1.35 | 1.34 | 1.33 | 1.31 | 1.30 | 1.28 | 1.26 | 1.25 | 1.24 | 1.22 | 1.21 | 1.19 |
| 60 | 1.35 | 1.42 | 1.41 | 1.38 | 1.37 | 1.35 | 1.33 | 1.32 | 1.31 | 1.30 | 1.29 | 1.27 | 1.25 | 1.24 | 1.22 | 1.21 | 1.19 | 1.17 | 1.15 |
| 120 | 1.34 | 1.40 | 1.39 | 1.37 | 1.35 | 1.33 | 1.31 | 1.30 | 1.29 | 1.28 | 1.26 | 1.24 | 1.22 | 1.21 | 1.19 | 1.18 | 1.16 | 1.13 | 1.10 |
| ∞ | 1.32 | 1.39 | 1.37 | 1.35 | 1.33 | 1.31 | 1.29 | 1.28 | 1.27 | 1.25 | 1.24 | 1.22 | 1.19 | 1.18 | 1.16 | 1.14 | 1.12 | 1.08 | 1.00 |

# VITA

Mr. Montree Chandamnearnkij was born in Bangkok, Thailand on July 2, 1974. He graduated at high school level from Santirat Witthayalai in 1992 and received a Bachelor Degree of Chemical Engineering form Chulalongkorn University in 1996. Immediately after graduation, he pursues his graduate study for a Master's Degree in Chemical Engineering at the Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University.