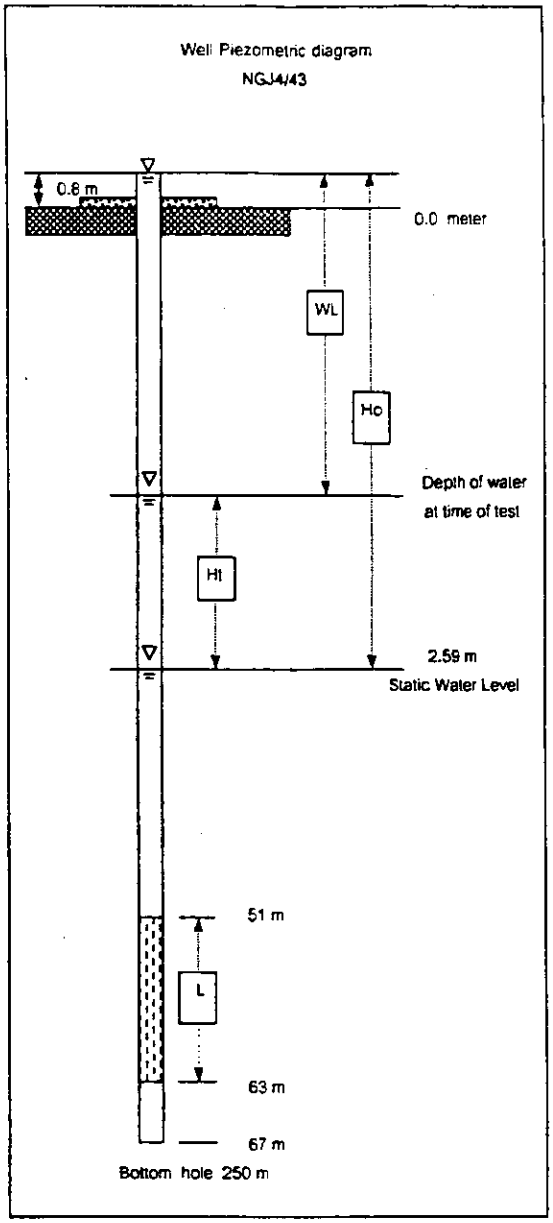
# APPENDIX— 4

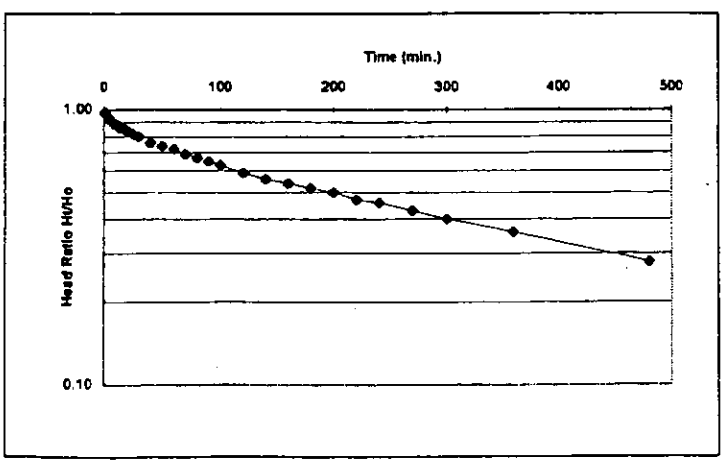
## Piezomtric Test Record

GEOTECHNICAL INVESTIGATION HOLE

| | | | |
|---|---|---|---|
| Location | NGAO BASIN | NGAO BASIN | Ground Elevation 303.804m |
| Northing | 2075209.378 | | Depth from Standpipe to SWL(Ho)=2.59m |
| Easting | 609816.571 | | Dia. of Pipe 0.0254 m. |
| Hole No. | NGJ 4/43 | | Tested & Analyzed by |

| Date/Time | Elapsed Time (min.) | Water Level (WL) below standpipe(m.) | Water Level (Ht) Ht = SWL-WL (m.) | Ht/Ho |
|---|---|---|---|---|
| 29-Jan-01 | 1 | 0.05 | 2.54 | 0.980 |
| | 2 | 0.09 | 2.50 | 0.965 |
| | 3 | 0.13 | 2.46 | 0.950 |
| | 4 | 0.15 | 2.44 | 0.940 |
| | 5 | 0.19 | 2.40 | 0.920 |
| | 6 | 0.20 | 2.39 | 0.920 |
| | 7 | 0.23 | 2.36 | 0.910 |
| | 8 | 0.25 | 2.34 | 0.900 |
| | 9 | 0.28 | 2.31 | 0.890 |
| | 10 | 0.28 | 2.31 | 0.890 |
| | 12 | 0.31 | 2.29 | 0.880 |
| | 14 | 0.34 | 2.25 | 0.860 |
| | 16 | 0.37 | 2.23 | 0.860 |
| | 18 | 0.39 | 2.21 | 0.850 |
| | 20 | 0.42 | 2.18 | 0.840 |
| | 25 | 0.46 | 2.14 | 0.820 |
| | 30 | 0.52 | 2.08 | 0.800 |
| | 40 | 0.60 | 1.99 | 0.760 |
| | 50 | 0.67 | 1.93 | 0.740 |
| | 60 | 0.72 | 1.87 | 0.720 |
| | 70 | 0.79 | 1.80 | 0.690 |
| | 80 | 0.84 | 1.75 | 0.670 |
| | 90 | 0.90 | 1.69 | 0.650 |
| | 100 | 0.95 | 1.64 | 0.630 |
| | 120 | 1.04 | 1.55 | 0.590 |
| | 140 | 1.13 | 1.47 | 0.560 |
| | 160 | 1.17 | 1.42 | 0.540 |
| | 180 | 1.24 | 1.35 | 0.520 |
| | 200 | 1.29 | 1.30 | 0.500 |
| | 220 | 1.35 | 1.24 | 0.470 |
| | 240 | 1.39 | 1.20 | 0.460 |
| | 270 | 1.47 | 1.12 | 0.430 |
| | 300 | 1.54 | 1.05 | 0.400 |
| | 360 | 1.65 | 0.94 | 0.360 |
| | 480 | 1.86 | 0.73 | 0.280 |




$$F = \frac{2\pi L}{\ln(L/R)} \qquad A = \pi r^2$$

$$K = \frac{A}{F(T2-T1)} \ln\frac{(H1)}{(H2)}$$

$$K = \frac{r^2}{2L} \ln(L/R) \frac{(\ln(H1)/H2))}{(T2-T1)}$$

F= Shape Factor of intake point
A= Standpipe area ($cm^2$)
K= Mean permeability, (cm/sec)
Ho= Water table of standing
Goundwater, (cm)
T1,T2= Elapsd time, (sec)
L= Length of test section, (cm)
R= Radius of standingpippe, (cm)
H1= Water table at time of
beginning of test, (cm)
H2= Water table at time of
finish of test, (cm)

Ln (H1/H2) and (T2-T1) are obtain from plot of observation.

**Fig. 29 Result of Permeability Test of NGJ4/43**

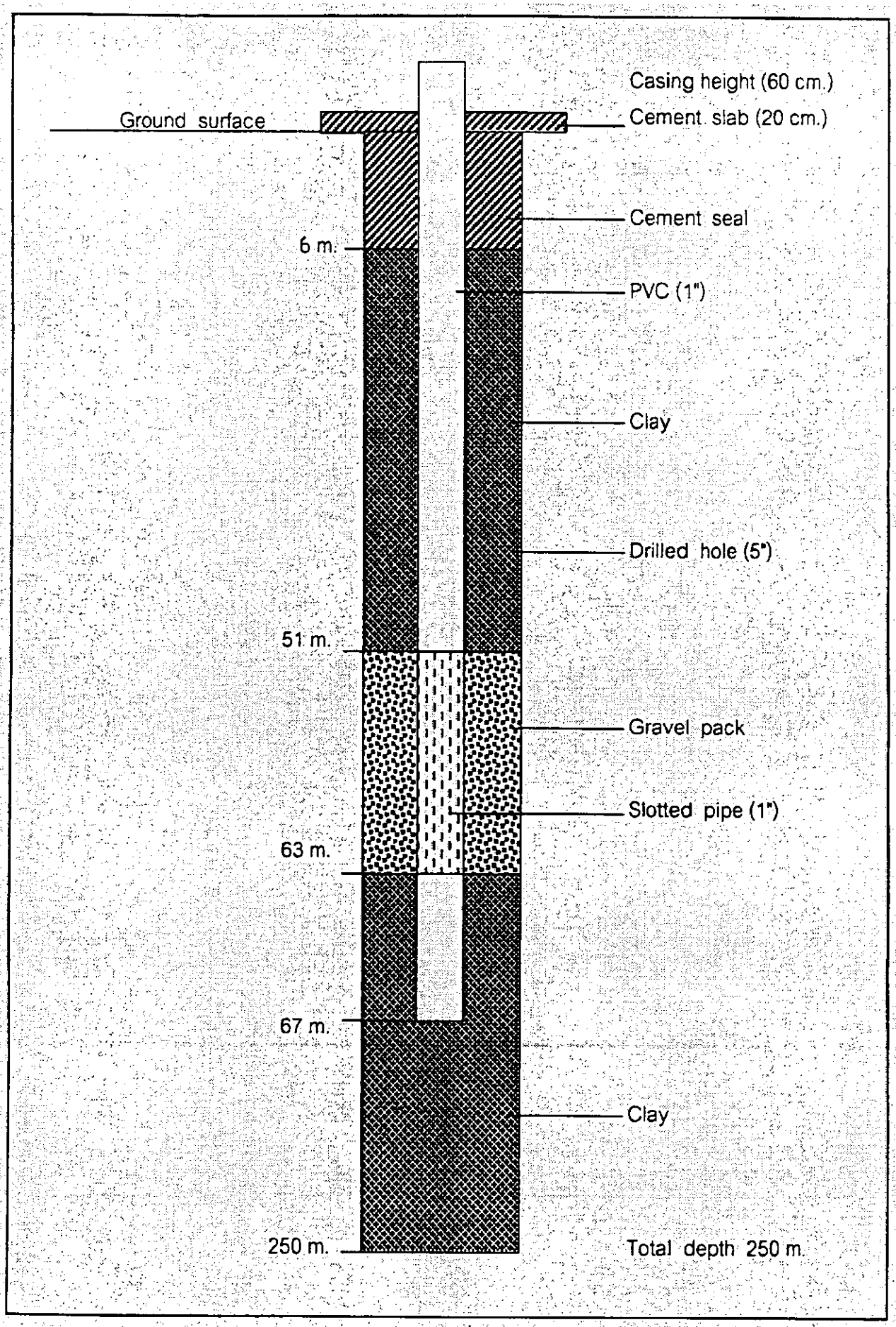
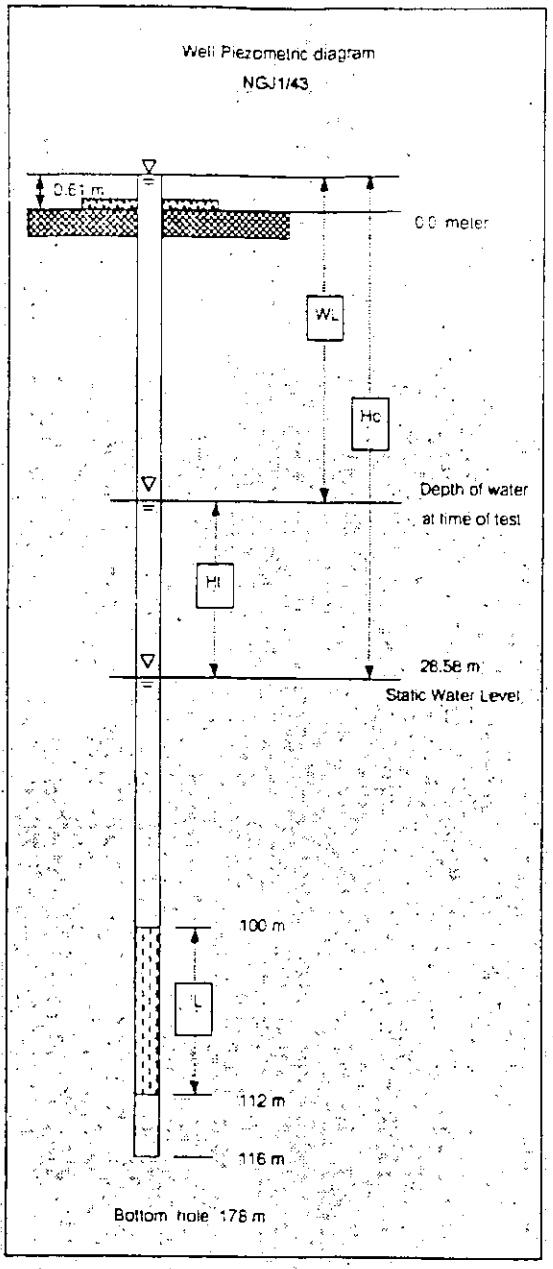


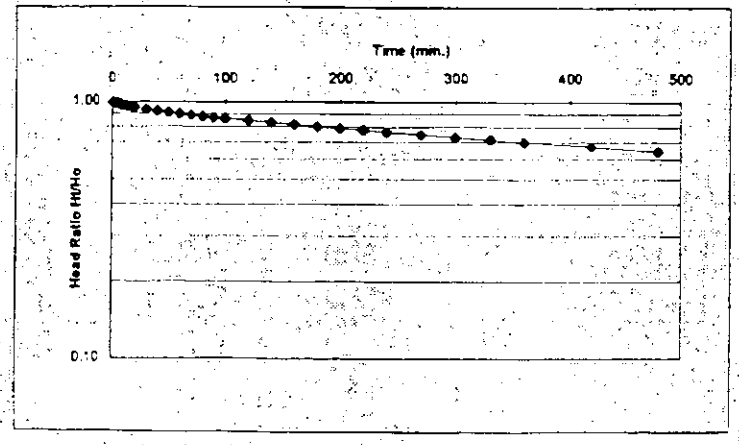

**Fig. 30 Cross Section of Piezometric Well NGJ4/43**

GEOTECHNICAL INVESTIGATION HOLE

| | | | |
|---|---|---|---|
| Location | NGAO BASIN | NGAO BASIN | Ground Elevation 316.456m |
| Northing | 2078914.891 | | Depth from Standpipe to SWL(Ho)=25.58m |
| Easting | 606531.336 | | Dia. of Pipe 0.0254 m. |
| Hole No. | NGJ 1/43 | | Tested & Analyzed by |

| Date/Time | Elapsed Time (min.) | Water Level (WLt) below standpipe(m.) | Water Level (Ht) Ht = SWL-WLt (m.) | Ht/Ho |
|---|---|---|---|---|
| 12-Feb-01 | 1 | 0.16 | 28.42 | 0.994 |
| | 2 | 0.30 | 28.28 | 0.989 |
| | 3 | 0.36 | 28.20 | 0.986 |
| | 4 | 0.47 | 28.11 | 0.983 |
| | 5 | 0.54 | 28.04 | 0.981 |
| | 6 | 0.61 | 27.97 | 0.987 |
| | 7 | 0.68 | 27.90 | 0.976 |
| | 8 | 0.75 | 27.83 | 0.973 |
| | 9 | 0.81 | 27.77 | 0.971 |
| | 10 | 0.87 | 27.71 | 0.969 |
| | 12 | 0.98 | 27.60 | 0.965 |
| | 14 | 1.08 | 27.50 | 0.962 |
| | 16 | 1.18 | 27.40 | 0.958 |
| | 18 | 1.28 | 27.30 | 0.955 |
| | 20 | 1.38 | 27.20 | 0.951 |
| | 30 | 1.81 | 26.77 | 0.936 |
| | 40 | 2.16 | 26.40 | 0.923 |
| | 50 | 2.53 | 26.05 | 0.911 |
| | 60 | 2.84 | 25.74 | 0.900 |
| | 70 | 3.15 | 25.43 | 0.889 |
| | 80 | 3.41 | 25.17 | 0.880 |
| | 90 | 3.74 | 24.84 | 0.869 |
| | 100 | 3.91 | 24.67 | 0.863 |
| | 120 | 4.37 | 24.21 | 0.847 |
| | 140 | 4.82 | 23.76 | 0.831 |
| | 160 | 5.25 | 23.33 | 0.816 |
| | 180 | 5.66 | 22.92 | 0.801 |
| | 200 | 6.00 | 22.58 | 0.790 |
| | 220 | 6.36 | 22.22 | 0.777 |
| | 240 | 6.70 | 21.88 | 0.765 |
| | 270 | 7.21 | 21.37 | 0.747 |
| | 300 | 7.69 | 20.89 | 0.730 |
| | 330 | 8.17 | 20.41 | 0.714 |
| | 360 | 8.59 | 19.99 | 0.699 |
| | 420 | 9.42 | 19.16 | 0.670 |
| | 480 | 10.22 | 18.36 | 0.642 |




$$F = \frac{2\pi L}{\ln(L/R)} \qquad A = \pi r^2$$

$$K = \frac{A}{F(T2-T1)} \ln\frac{(H1)}{(H2)}$$

$$K = \frac{r^2}{2L} \ln(L/R) \frac{(\ln(H1/H2))}{(T2-T1)}$$

F= Shape Factor of intake point
A= Standpipe area ($cm^2$)
K= Mean permeability, (cm/sec)
Ho= Water table of standing Goundwater, (cm)
T1,T2= Elapsd time, (sec)
L= Length of test section, (cm)
R= Radius of standpipe, (cm)
H1= Water table at time of beginning of test, (cm)
H2= Water table at time of finish of test, (cm)

Ln (H1/H2) and (T2-T1) are obtain from plot of observation.

**Fig. 31 Result of Permeability Test of NGJ1/43**

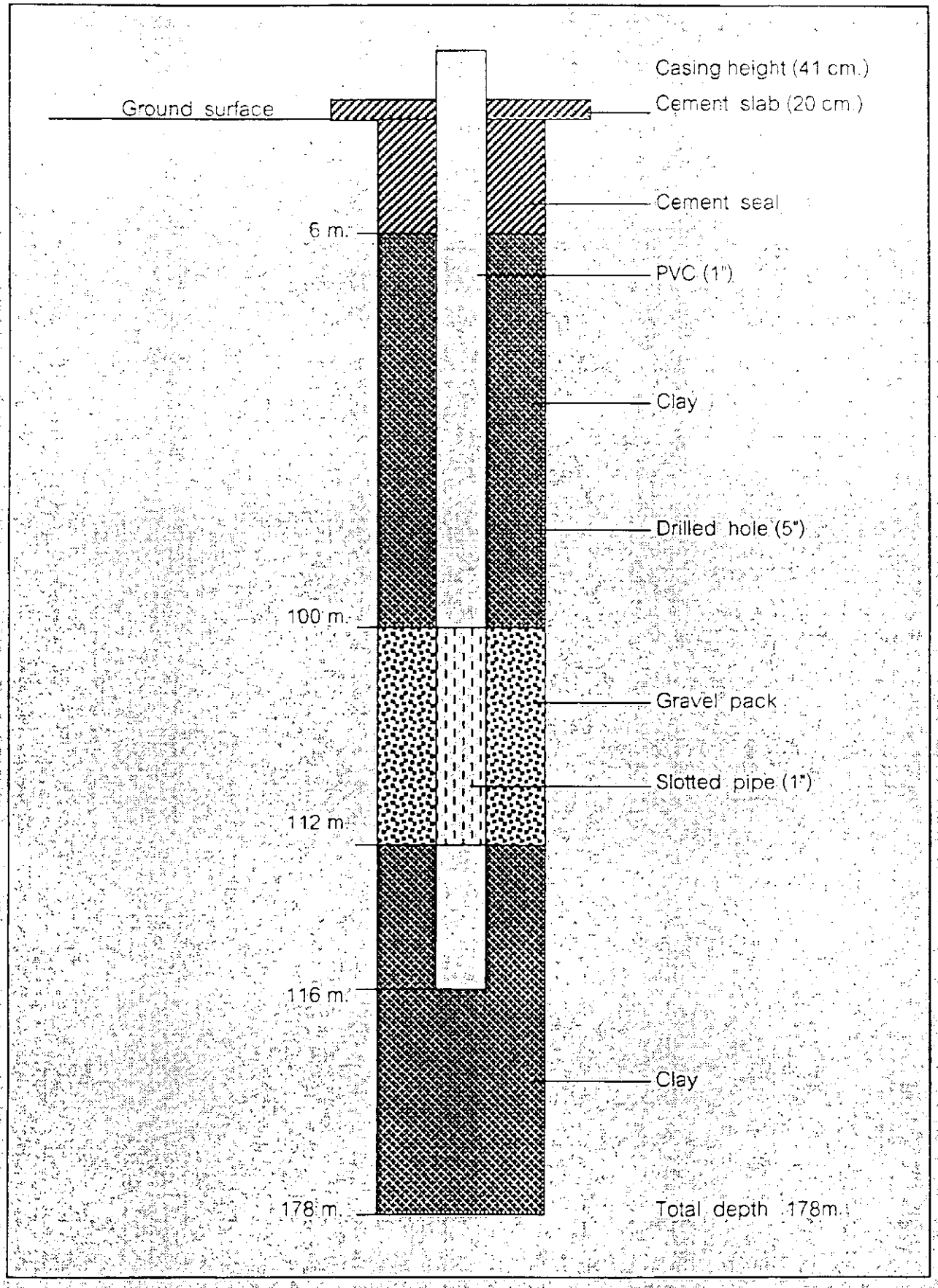



**Fig. 32 Cross Section of Piezometric Well NGJ1/43**

# APPENDIX－5

## Screening and Float & Sink Test Result on Bulk and Core Sample

PARTICLE SIZE ANALYSIS

Total weight : 630 Kg.

| DATE | Size Fraction | Weight | Mass | Cumulative Mass (%) | |
|---|---|---|---|---|---|
| 04/12/2000 | (mm.) | (Kg.) | (%) | Retained | Passed |
| | +50.0 | 68.0 | 11.21 | 11.21 | 88.79 |
| | -50.0+25.0 | 245.2 | 40.44 | 51.65 | 48.35 |
| | -25.0+10.0 | 125.0 | 20.61 | 72.26 | 27.74 |
| | -10.0+3.0 | 85.5 | 14.1 | 86.36 | 13.64 |
| | -3.0+0.5 | 53.8 | 8.86 | 95.22 | 4.78 |
| | -0.5 | 28.9 | 4.78 | 100 | - |

**Float and Sink Data**

| Sample Name | Relative Density | Weight | Mass | Ash | Sulphur |
|---|---|---|---|---|---|
| | Fraction Float-Sink | (g.) | (%) | (%) | (%) |
| : STANDARD COAL | < 1.30 | 1,615.60 | 56.54 | 10.78 | 3.95 |
| | 1.35 | 464.70 | 16.26 | 20.86 | 4.95 |
| | 1.40 | 311.00 | 10.88 | 20.13 | 4.32 |
| | 1.45 | 4.60 | 0.16 | 17.25 | 4.19 |
| | 1.50 | 49.10 | 1.72 | 28.94 | 3.93 |
| | 1.55 | 67.50 | 2.36 | 20.15 | 3.96 |
| | 1.60 | 144.90 | 5.07 | 19.34 | 3.85 |
| | 1.70 | 138.00 | 4.83 | 21.29 | 4.28 |
| | 1.80 | 37.70 | 1.32 | 35.40 | 4.62 |
| | >1.80 | 24.50 | 0.86 | | |

| Sample Name | Relative Density | Weight | Mass | Ash | Sulphur |
|---|---|---|---|---|---|
| | Fraction Float-Sink | (g.) | (%) | (%) | (%) |
| : + 50.0 mm. | <1.30 | 17,345.90 | 77.07 | 13.39 | 3.98 |
| | 1.35 | 2,679.30 | 11.90 | 18.83 | 4.25 |
| | 1.40 | 1,266.30 | 5.63 | 28.13 | 4.85 |
| | 1.50 | 813.40 | 3.62 | 31.32 | 6.85 |
| | 1.60 | 401.60 | 1.78 | 42.47 | 8.16 |

| Sample Name | Relative Density | Weight | Mass | Ash | Sulphur |
|---|---|---|---|---|---|
| | Fraction Float-Sink | (g.) | (%) | (%) | (%) |
| - 50.0mm.+25.0mm. | <1.30 | 15,733.50 | 67.66 | 13.40 | 4.16 |
| | 1.35 | 1,666.90 | 7.17 | 20.78 | 4.70 |
| | 1.40 | 2,057.40 | 8.85 | 27.29 | 5.12 |
| | 1.50 | 1,418.60 | 6.10 | 32.36 | 6.14 |
| | 1.60 | 1,718.40 | 7.39 | 42.19 | 5.16 |
| | 1.70 | 409.44 | 1.76 | 54.95 | 3.28 |
| | 1.80 | 249.20 | 1.07 | 66.98 | 2.78 |

| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| -25.0mm.+10.0mm. | <1.30 | 14,682.80 | 66.21 | 23.40 | 4.28 |
| | 1.35 | 1,259.30 | 5.68 | 23.96 | 5.17 |
| | 1.40 | 1,764.00 | 7.95 | 29.83 | 5.48 |
| | 1.50 | 1,754.60 | 7.91 | 32.54 | 5.76 |
| | 1.60 | 1,178.60 | 5.31 | 40.51 | 6.41 |
| | 1.70 | 625.80 | 2.82 | 51.83 | 5.15 |
| | 1.80 | 427.10 | 1.93 | 55.87 | 4.19 |
| | >1.80 | 484.00 | 2.19 | 57.50 | 3.03 |

| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| -10.0mm.+3.0mm. | <1.30 | 3,550.20 | 46.37 | 15.57 | 5.19 |
| | 1.35 | 268.80 | 3.51 | 22.34 | 5.80 |
| | 1.40 | 500.90 | 6.54 | 24.23 | 4.63 |
| | 1.50 | 1,435.10 | 18.75 | 23.20 | 4.28 |
| | 1.60 | 647.30 | 8.45 | 30.84 | 4.72 |
| | 1.70 | 575.80 | 7.51 | 38.06 | 5.43 |
| | 1.80 | 335.50 | 4.39 | 47.35 | 5.27 |
| | >1.80 | 342.80 | 4.48 | 56.54 | 4.52 |

| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| -3.0mm.+0.5mm. | <1.30 | 32.70 | 0.91 | 15.46 | 4.94 |
| | 1.35 | 48.85 | 1.36 | 14.73 | 4.78 |
| | 1.40 | 21.44 | 0.60 | 16.70 | 4.21 |
| | 1.50 | 169.40 | 4.72 | 14.31 | 3.63 |
| | 1.60 | 1,122.84 | 31.31 | 14.33 | 3.60 |
| | 1.70 | 1,308.64 | 36.49 | 14.69 | 3.59 |
| | 1.80 | 541.10 | 15.09 | 30.50 | 5.72 |
| | >1.80 | 341.32 | 9.52 | 43.58 | 5.85 |

| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| -0.5mm. | <1.30 | 1.30 | 1.12 | 20.74 | 4.49 |
| | 1.35 | 4.30 | 2.34 | 21.43 | 4.81 |
| | 1.40 | 6.40 | 3.79 | 22.11 | 3.88 |
| | 1.50 | 24.20 | 14.33 | 20.97 | 4.32 |
| | 1.60 | 47.30 | 28.39 | 19.71 | 3.95 |
| | 1.70 | 32.20 | 19.08 | 23.57 | 4.39 |
| | 1.80 | 41.10 | 24.35 | 28.48 | 4.40 |
| | >1.80 | 10.30 | 6.10 | 38.84 | 7.32 |

PARTICLE SIZE ANALYSIS

Total weight : 7.4 Kg.

| MARK | Size Fraction (mm.) | Weight (g.) | Mass | Cumulative Mass (%) | |
|---|---|---|---|---|---|
| | | | | Retained | Passed |
| P3 | +10.0 | 4827.0 | 67.02 | 67.02 | 32.98 |
| Depth : 5.60 m.-8.82 m. | -10.0+0.5 | 2073.0 | 28.78 | 95.80 | 4.20 |
| | -0.5 | 302.3 | 4.20 | 100.00 | - |

PARTICLE SIZE ANALYSIS

Total weight : 10 Kg.

| MARK | Size Fraction (mm.) | Weight (g.) | Mass | Cumulative Mass (%) | |
|---|---|---|---|---|---|
| | | | | Retained | Passed |
| N.3-4 | +10.0 | 7373.0 | 74.59 | 74.59 | 25.41 |
| Depth : 158.5m.-162.73m. | -10.0+0.5 | 2228.0 | 22.54 | 97.13 | 2.87 |
| | -0.5 | 283.6 | 2.87 | 100.00 | - |

PARTICLE SIZE ANALYSIS

Total weight : 15 Kg.

| MARK | Size Fraction (mm.) | Weight (g.) | Mass | Cumulative Mass (%) | |
|---|---|---|---|---|---|
| | | | | Retained | Passed |
| N.3-6 | +10.0 | 10610.0 | 71.67 | 71.67 | 28.33 |
| Depth : 172.0m.-178.55m. | -10.0+0.5 | 3690.0 | 24.93 | 96.60 | 3.40 |
| | -0.5 | 503.7 | 3.40 | 100.00 | - |

Float and Sink Data

| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| P3 | <1.30 | 1,426.20 | 40.90 | 14.07 | 4.41 |
| : + 10.0 mm. | 1.35 | 154.40 | 4.43 | 23.03 | 5.42 |
| | 1.40 | 272.70 | 7.82 | 26.76 | 5.26 |
| | 1.50 | 564.90 | 16.20 | 29.25 | 5.11 |
| | 1.60 | 427.60 | 12.26 | 38.37 | 4.60 |
| | 1.80 | 421.80 | 12.10 | 54.97 | 3.63 |
| | >1.80 | 219.70 | 6.30 | 68.65 | 1.95 |

| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| P3 | <1.30 | 340.80 | 25.56 | 15.74 | 5.15 |
| | 1.35 | 127.80 | 9.59 | 21.48 | 5.26 |
| : - 10.0 mm.+0.5 mm. | 1.40 | 85.80 | 6.44 | 24.09 | 4.70 |
| | 1.50 | 174.10 | 13.06 | 27.98 | 5.11 |
| | 1.60 | 172.80 | 12.96 | 32.89 | 4.97 |
| | 1.80 | 296.30 | 22.22 | 42.12 | 4.51 |
| | >1.80 | 135.70 | 10.18 | 59.03 | 3.59 |

Float and Sink Data

| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| N.3-4 : + 10.0 mm. | <1.30 | 49.10 | 0.79 | 17.57 | 4.79 |
| | 1.35 | 824.40 | 13.30 | 22.60 | 4.65 |
| | 1.40 | 324.90 | 5.24 | 19.75 | 4.74 |
| | 1.50 | 1,250.40 | 20.17 | 28.68 | 5.47 |
| | 1.60 | 999.70 | 16.13 | 36.76 | 6.10 |
| | 1.80 | 989.50 | 15.96 | 46.06 | 5.29 |
| | >1.80 | 1,760.00 | 28.40 | 73.70 | 6.29 |

| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| N.3-4 : - 10.0 mm.+0.5 mm. | <1.30 | 218.50 | 14.00 | 20.85 | 4.66 |
| | 1.35 | 164.10 | 10.51 | 21.70 | 4.90 |
| | 1.40 | 163.60 | 10.48 | 25.17 | 5.15 |
| | 1.50 | 134.80 | 8.64 | 27.52 | 5.07 |
| | 1.60 | 236.10 | 15.13 | 33.04 | 5.69 |
| | 1.80 | 294.80 | 18.89 | 42.50 | 6.33 |
| | >1.80 | 348.90 | 22.35 | 72.06 | 7.78 |

Float and Sink Data

| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| N.3-6 : + 10.0 mm. | <1.30 | 898.30 | 11.31 | 19.00 | 4.27 |
| | 1.35 | 273.30 | 3.44 | 21.99 | 4.74 |
| | 1.40 | 593.80 | 7.48 | 21.74 | 4.13 |
| | 1.50 | 981.90 | 12.36 | 25.68 | 4.47 |
| | 1.60 | 1,699.50 | 21.40 | 34.48 | 4.92 |
| | 1.80 | 1,683.80 | 21.20 | 49.58 | 4.33 |
| | >1.80 | 1,810.50 | 22.80 | 69.27 | 2.68 |

| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| N.3-6 : - 10.0 mm.+0.5 mm. | <1.30 | 172.90 | 6.96 | 18.23 | 4.58 |
| | 1.35 | 156.80 | 6.31 | 19.42 | 4.70 |
| | 1.40 | 144.50 | 5.81 | 20.60 | 4.22 |
| | 1.50 | 355.50 | 14.31 | 25.93 | 4.66 |
| | 1.60 | 312.20 | 12.56 | 31.05 | 4.71 |
| | 1.80 | 840.10 | 33.81 | 37.35 | 4.45 |
| | >1.80 | 503.10 | 20.24 | 73.70 | 5.03 |

| Sample Name | Size | Ash (%) | Sulphur (%) |
|---|---|---|---|
| P3 | - 0.5 mm. | 46.33 | 6.72 |
| N.3-4 | - 0.5 mm. | 52.58 | 6.45 |
| N.3-6 | - 0.5 mm. | 50.17 | 5.87 |

PARTICLE SIZE ANALYSIS

Total weight : 1.8 kg

| MARK | Size Fraction (mm.) | Weight (g.) | Mass (%) | Cumulative Mass (%) | |
|---|---|---|---|---|---|
| | | | | Retained | Passed |
| N. 1-3 | +10.0 | 1240.40 | 72.79 | 72.79 | 27.21 |
| Depth : 98.43 m. - 99.15 m. | -10.0+0.5 | 430.20 | 25.24 | 98.03 | 1.97 |
| | -0.5 | 33.50 | 1.97 | 100.00 | - |
| | | | | | |

**Float and Sink Data**

| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| N.1-3 | <1.30 | 38.20 | 3.95 | 13.94 | 5.29 |
| | 1.35 | 422.90 | 43.76 | 18.25 | 4.41 |
| + 10.0 MM | 1.40 | 252.90 | 26.17 | 22.31 | 7.40 |
| | 1.50 | 119.20 | 12.34 | 29.92 | 8.15 |
| | 1.60 | 46.10 | 4.77 | 42.29 | 5.93 |
| | 1.80 | 71.50 | 7.40 | 53.17 | 6.73 |
| | >1.80 | 15.50 | 1.60 | 66.57 | 4.63 |

| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| N.1-3 | <1.30 | 13.80 | 4.43 | 15.67 | 5.04 |
| | 1.35 | 71.10 | 22.83 | 18.69 | 6.01 |
| 10.0 mm. + 0.5 m | 1.40 | 66.20 | 21.25 | 22.73 | 6.73 |
| | 1.50 | 41.30 | 13.26 | 25.29 | 6.89 |
| | 1.60 | 73.00 | 23.43 | 29.52 | 7.34 |
| | 1.80 | 35.00 | 11.24 | 43.15 | 7.05 |
| | >1.80 | 11.10 | 3.56 | 61.71 | 8.99 |

| Sample Name | Size | Ash (%) | Sulphur (%) |
|---|---|---|---|
| N.1-3 | -0.5 mm. | 35.53 | 6.60 |

PARTICLE SIZE ANALYSIS

Total weight : 4.2 Kg.

| MARK | Size Fraction (mm.) | Weight (g.) | Mass | Cummulative Mass (%) | |
|---|---|---|---|---|---|
| | | | | Retained | Passed |
| N5-1 S | +10.0 | 2,900.00 | 69.97 | 69.97 | 30.03 |
| Depth : 93.20 m. - 95.40 m. | -10.0+0.5 | 1,131.80 | 27.31 | 97.28 | 2.72 |
| | -0.5 | 112.60 | 2.72 | 100.00 | - |
| | | 4144.4 | | | |

PARTICLE SIZE ANALYSIS

Total weight : 3.8 Kg.

| MARK | Size Fraction (mm.) | Weight (g.) | Mass | Cummulative Mass (%) | |
|---|---|---|---|---|---|
| | | | | Retained | Passed |
| N.5-13 S | +10.0 | 2,600.00 | 74.87 | 74.87 | 25.13 |
| Depth : 164.85 m.-166.95 m. | -10.0+0.5 | 744.40 | 21.44 | 96.31 | 3.69 |
| | -0.5 | 128.10 | 3.69 | 100.00 | - |

Float and Sink Data

| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| N.5-1 S | <1.30 | 410.30 | 19.39 | 15.30 | 2.06 |
| | 1.35 | 446.10 | 21.08 | 19.62 | 2.34 |
| : + 10.0 mm. | 1.40 | 473.10 | 22.35 | 24.91 | 3.02 |
| | 1.50 | 216.50 | 10.23 | 32.07 | 4.02 |
| | 1.60 | 183.90 | 8.69 | 35.63 | 4.31 |
| | 1.80 | 286.30 | 13.53 | 44.74 | 3.80 |
| | >1.80 | 100.20 | 4.73 | 52.51 | 10.36 |
| | | 2,116.40 | 100.00 | | |

| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| N.5-1 S | <1.30 | 102.80 | 12.16 | 17.27 | 2.36 |
| | 1.35 | 48.30 | 5.72 | 18.54 | 2.30 |
| : - 10.0 mm.+0.5 mm. | 1.40 | 143.40 | 16.97 | 22.30 | 2.59 |
| | 1.50 | 102.80 | 12.16 | 24.48 | 2.61 |
| | 1.60 | 194.00 | 22.96 | 26.38 | 2.82 |
| | 1.80 | 159.40 | 18.86 | 33.78 | 3.20 |
| | >1.80 | 94.40 | 11.17 | 53.86 | 10.26 |
| | | 845.10 | 100.00 | | |

| Sample Name | Size | Ash (%) | Sulphur (%) |
|---|---|---|---|
| N.5-1 S | - 0.5 mm. | 34.74 | 5.70 |

Float and Sink Data

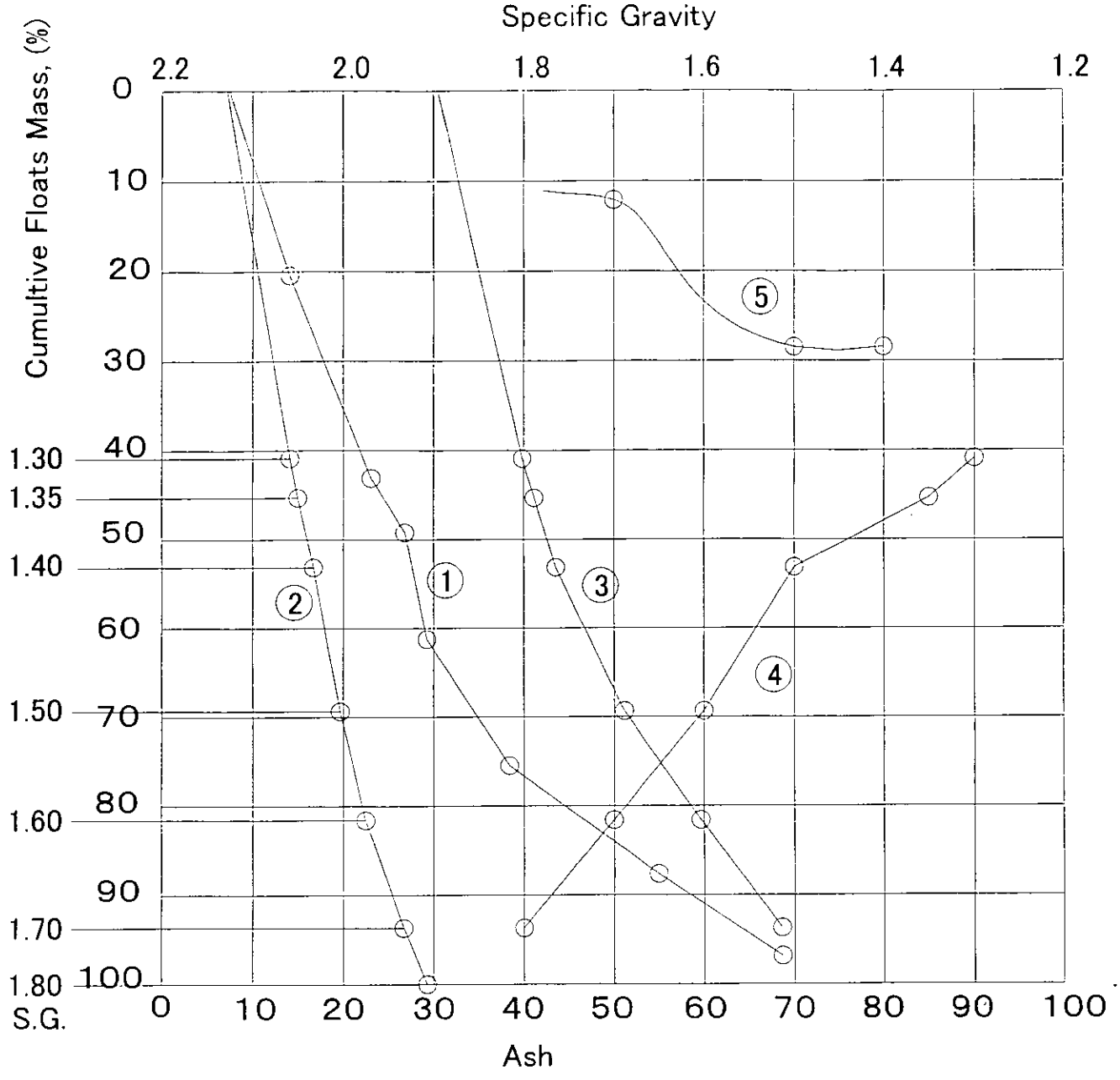
| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| N.5-13 S | <1.30 | 290.40 | 17.04 | 19.69 | 4.97 |
| | 1.35 | 105.10 | 6.17 | 23.73 | 5.19 |
| : + 10.0 mm. | 1.40 | 176.00 | 10.33 | 28.95 | 5.38 |
| | 1.50 | 160.50 | 9.42 | 34.63 | 5.73 |
| | 1.60 | 191.80 | 11.26 | 39.65 | 4.80 |
| | 1.80 | 547.60 | 32.13 | 52.31 | 4.22 |
| | >1.80 | 232.70 | 13.65 | 67.43 | 2.54 |
| | | 1,704.10 | 99.995 | | |

| Sample Name | Relative Density Fraction Float-Sink | Weight (g.) | Mass (%) | Ash (%) | Sulphur (%) |
|---|---|---|---|---|---|
| N.5-13 S | <1.30 | 100.40 | 22.09 | 20.65 | 5.00 |
| | 1.35 | 15.20 | 3.34 | 22.30 | 5.02 |
| : - 10.0 mm.+0.5 mm. | 1.40 | 43.60 | 9.59 | 25.50 | 5.06 |
| | 1.50 | 58.90 | 12.96 | 28.76 | 4.89 |
| | 1.60 | 66.10 | 14.54 | 32.92 | 4.48 |
| | 1.80 | 125.20 | 27.55 | 44.05 | 5.15 |
| | >1.80 | 45.10 | 9.92 | 55.99 | 8.60 |
| | | 454.50 | 100.000 | | |

| Sample Name | Size | Ash (%) | Sulphur (%) |
|---|---|---|---|
| N.5-13 S | - 0.5 mm. | 37.83 | 6.69 |

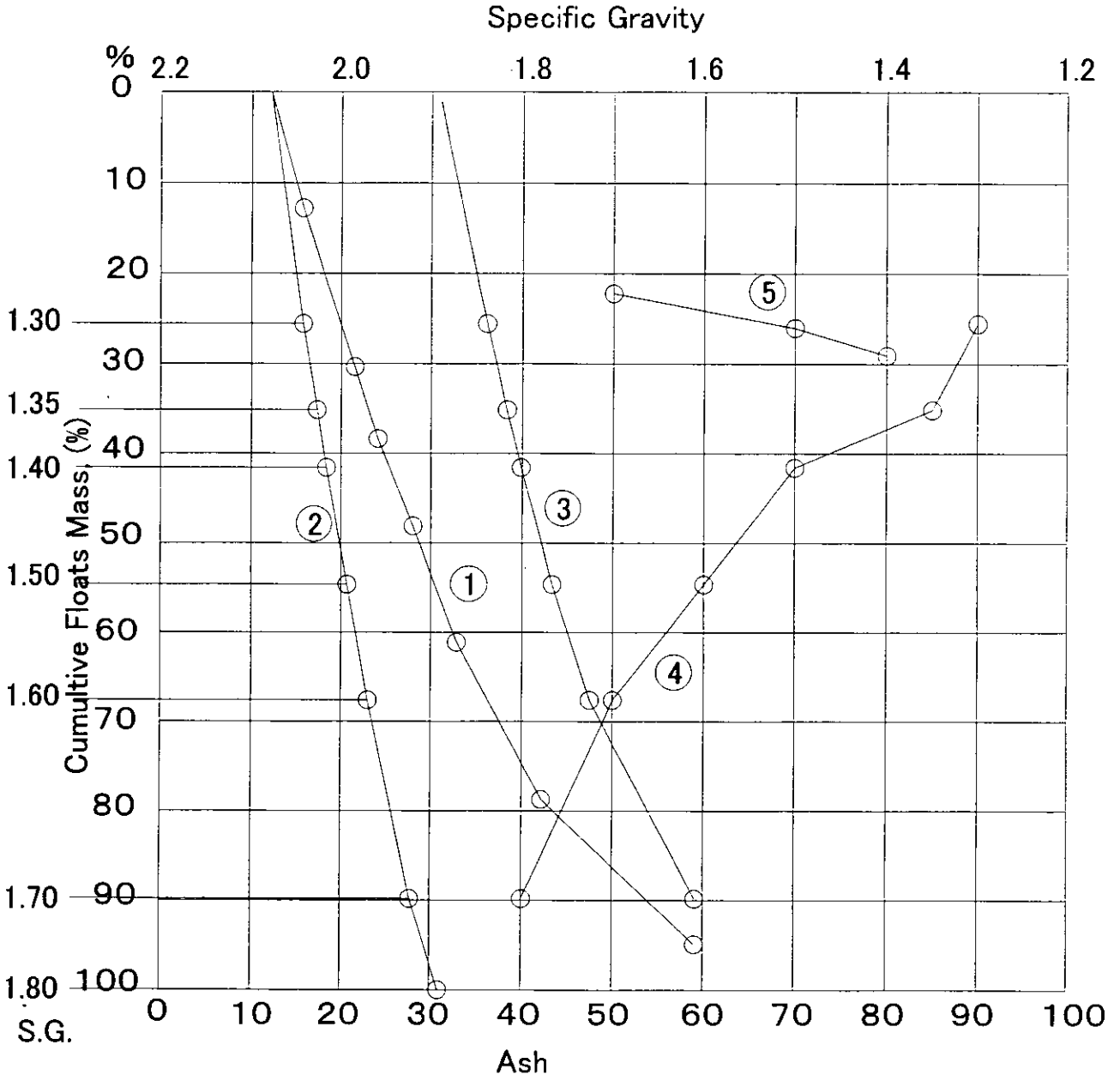
# APPENDIX－6

## Washability Curve of Bulk and Core Sample



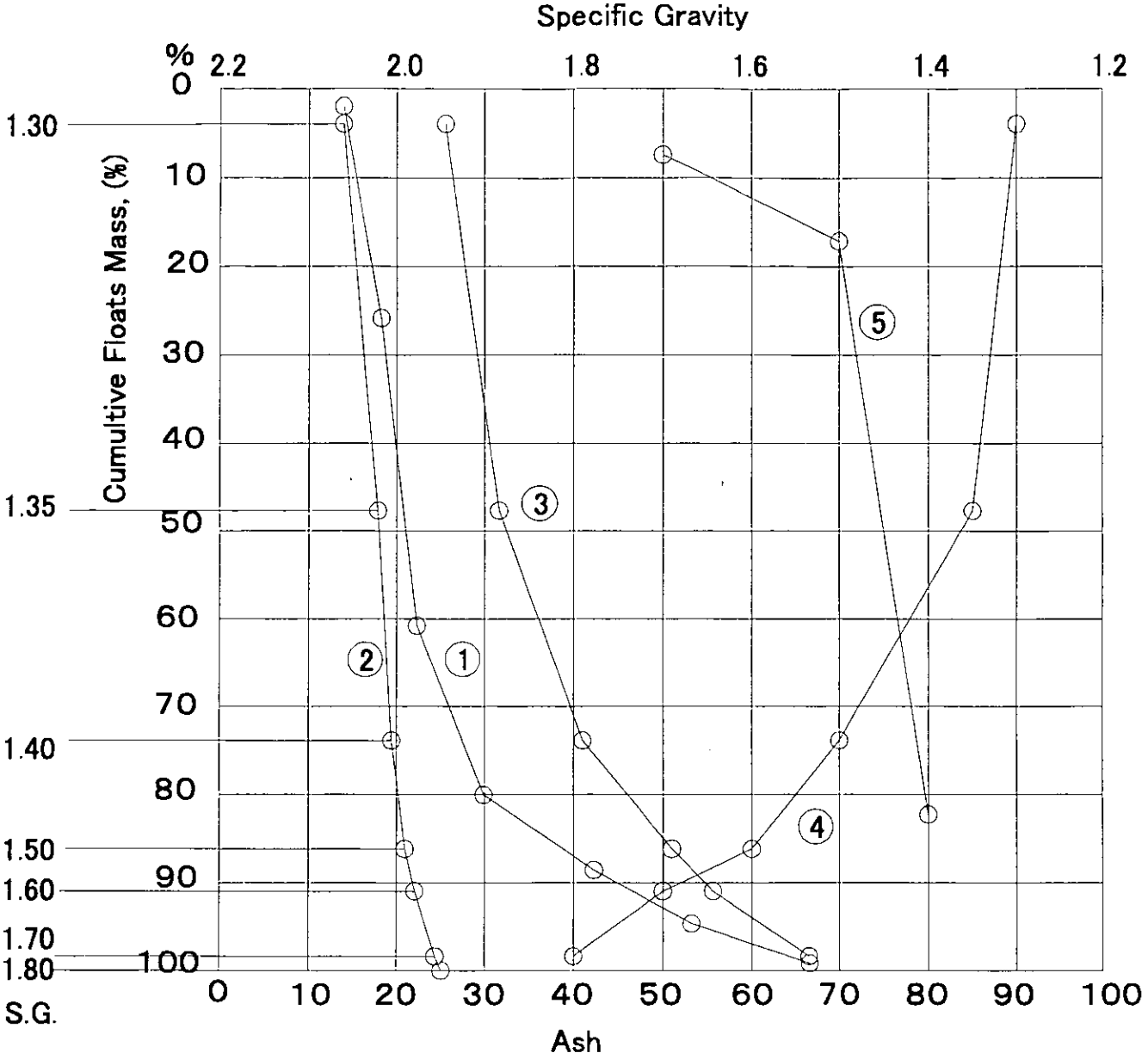

① Observed curve
② Floating curve
③ Sinking curve
④ Specific Gravity curve
⑤ Difficulty curve

Washability Curve PH3 [+10mm]



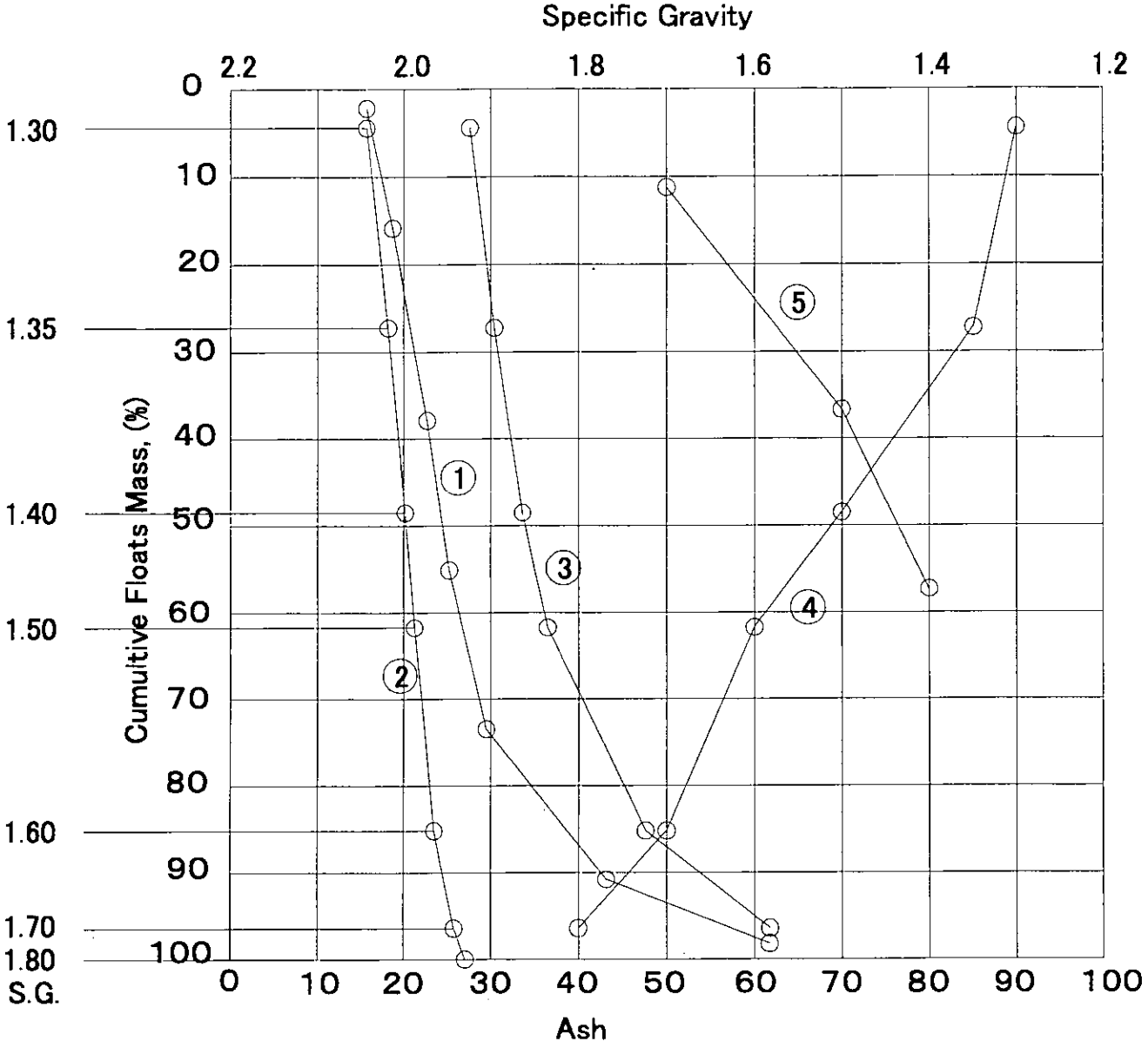

Washability Curve PH3 [−10mm − +5mm]

① ○——○ Observed curve
② ○——○ Floating curve
③ ○——○ Sinking curve
④ ○——○ Specific Gravity curve
⑤ ○——○ Difficulty curve



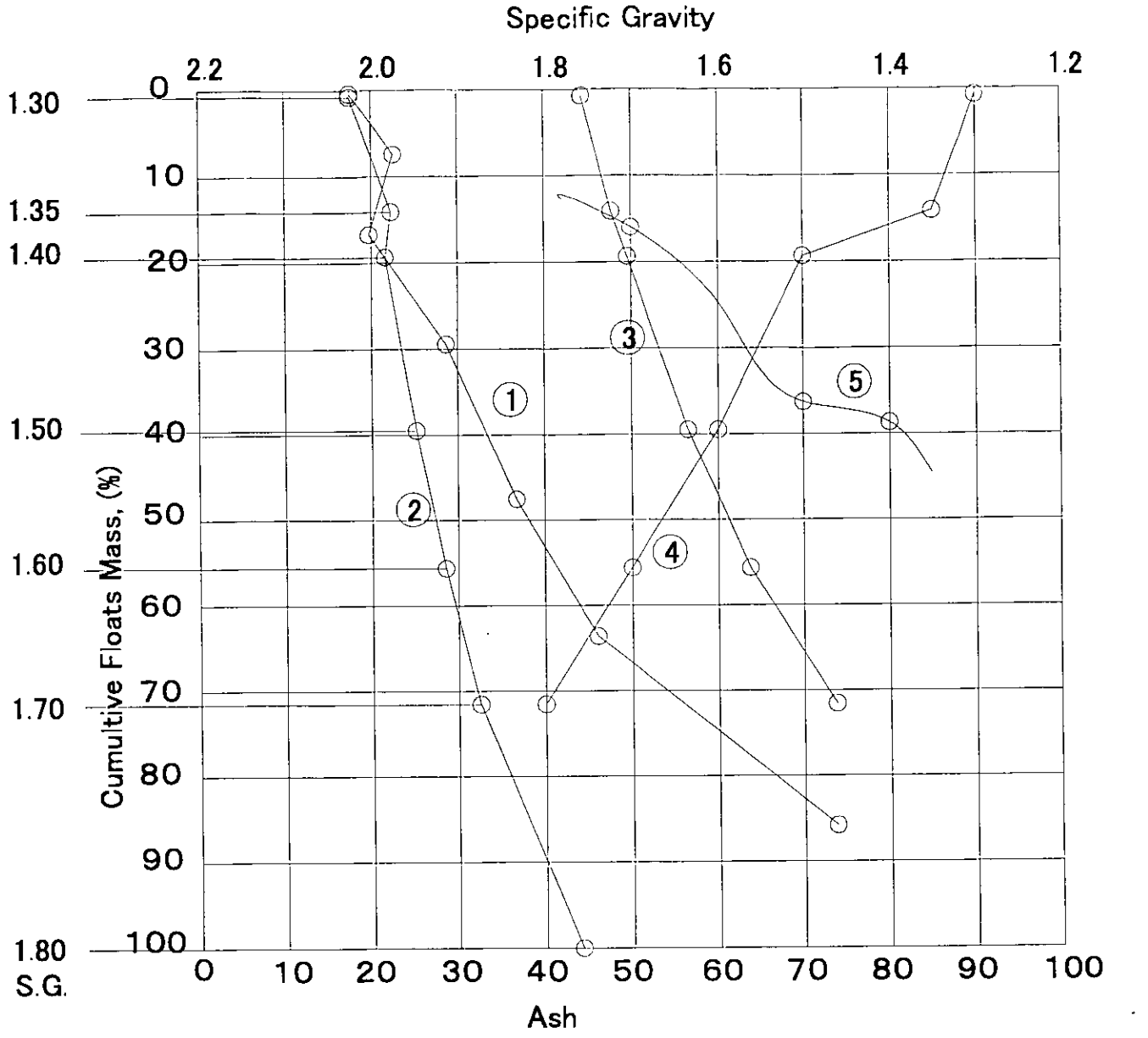

① Observed curve
② Floating curve
③ Sinking curve
④ Specific Gravity curve
⑤ Difficulty curve

Washability Curve N1-3 [+10mm]



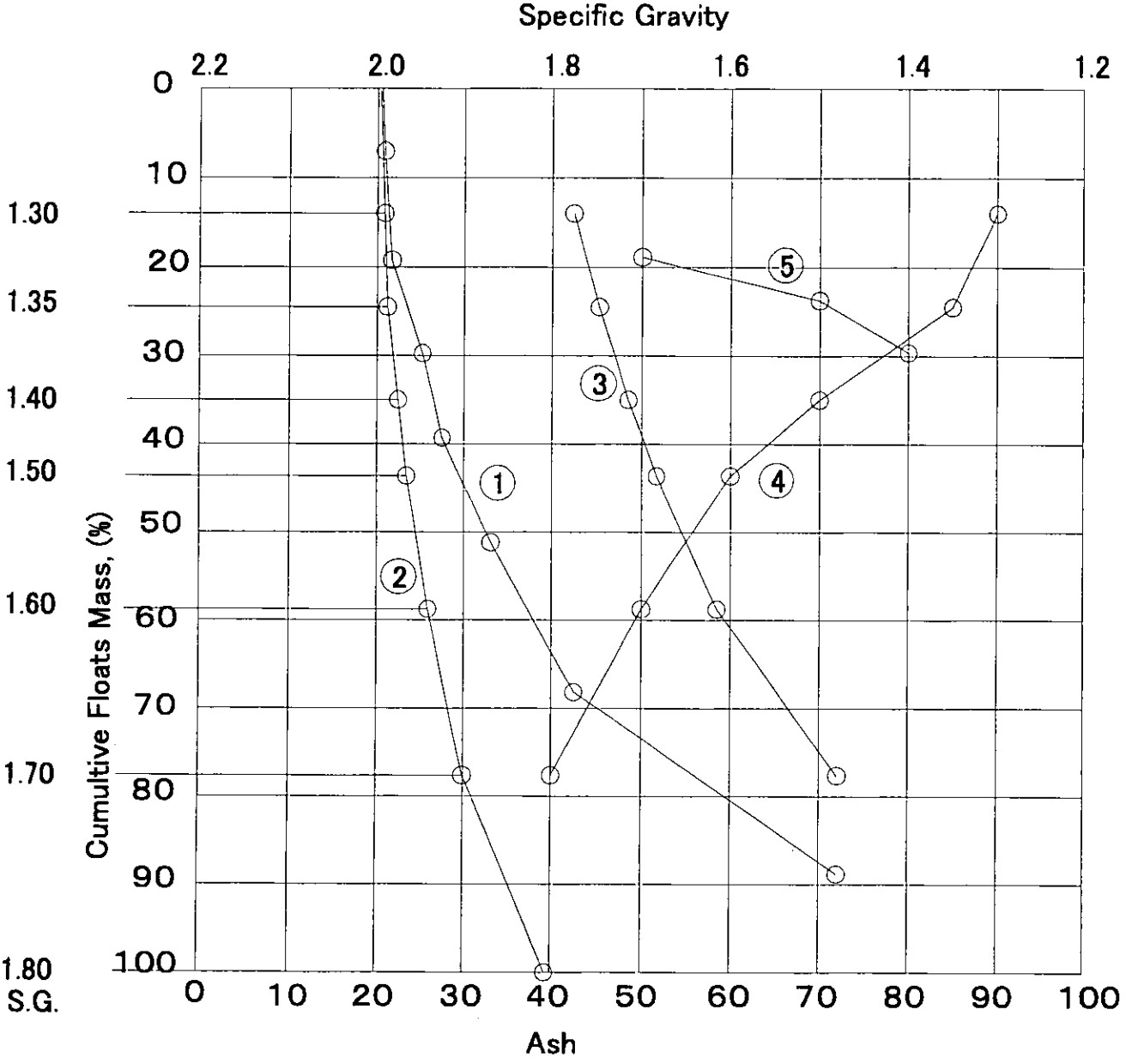

Washability Curve N1-3 [-10mm - +5mm]

① Observed curve
② Floating curve
③ Sinking curve
④ Specific Gravity curve
⑤ Difficulty curve



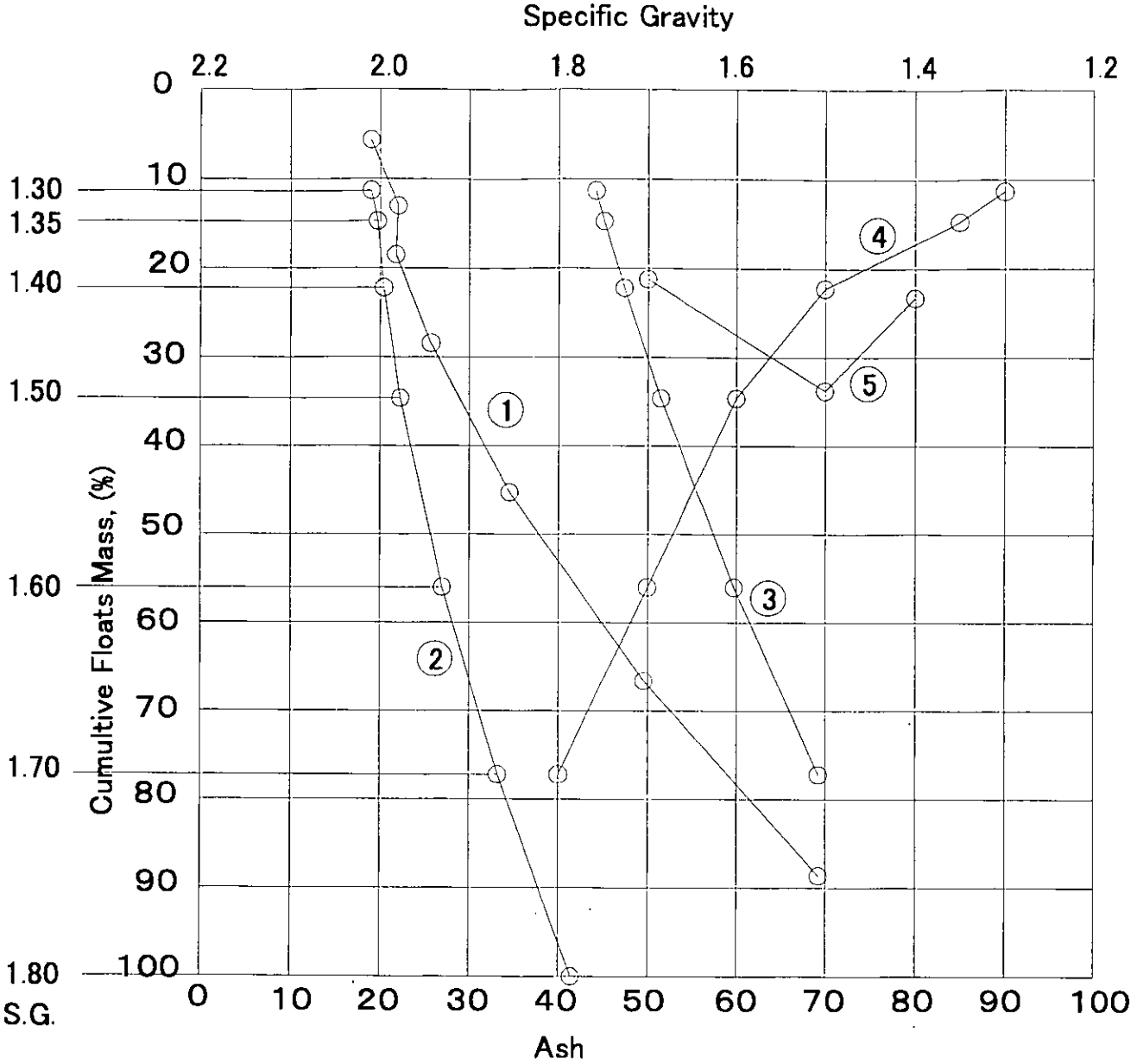

① Observed curve
② Floating curve
③ Sinking curve
④ Specific Gravity curve
⑤ Difficulty curve

Washability Curve N3-4 [+10mm]



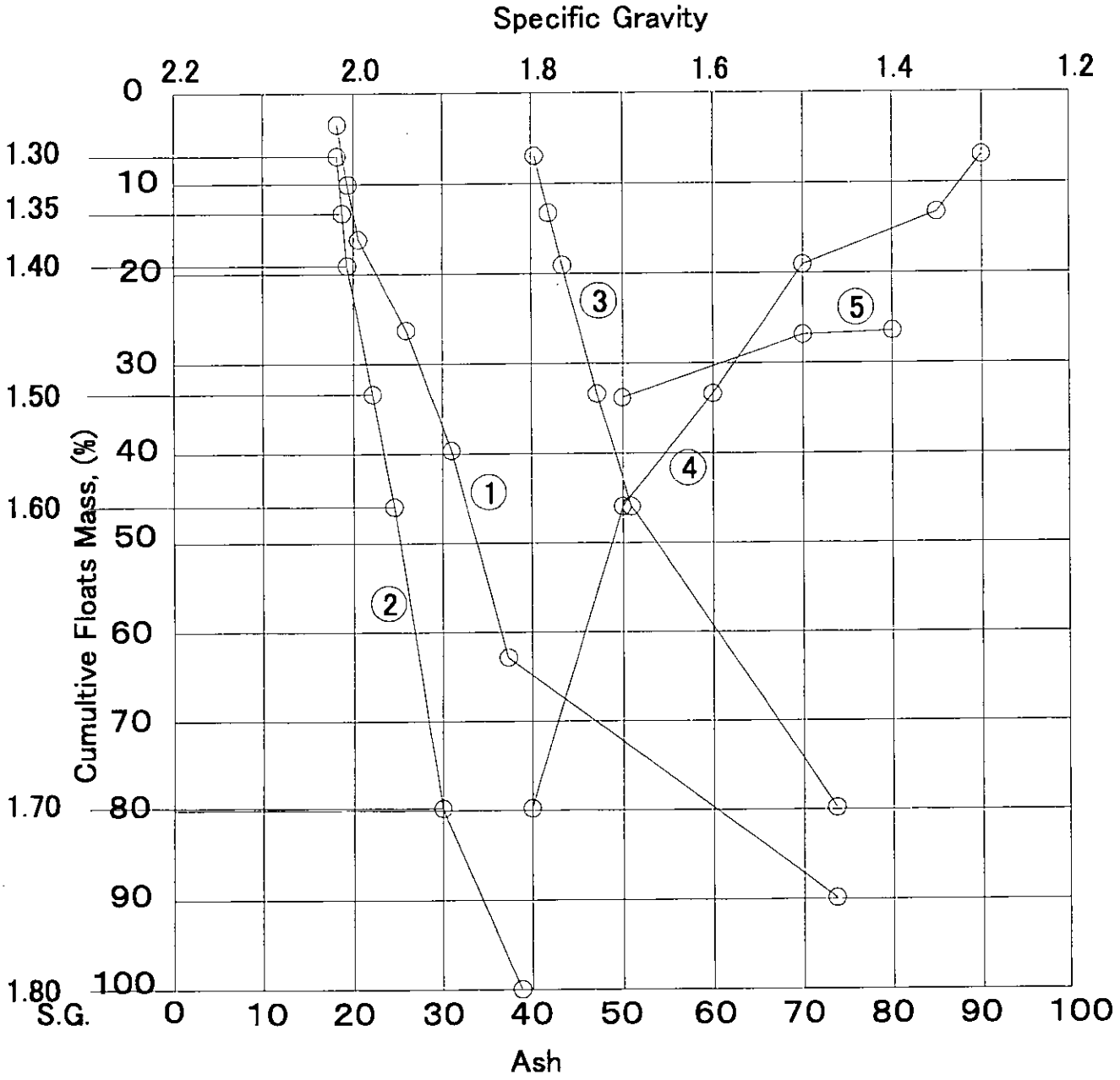

Washability Curve N3-4 [-10mm - +5mm]

① Observed curve
② Floating curve
③ Sinking curve
④ Specific Gravity curve
⑤ Difficulty curve



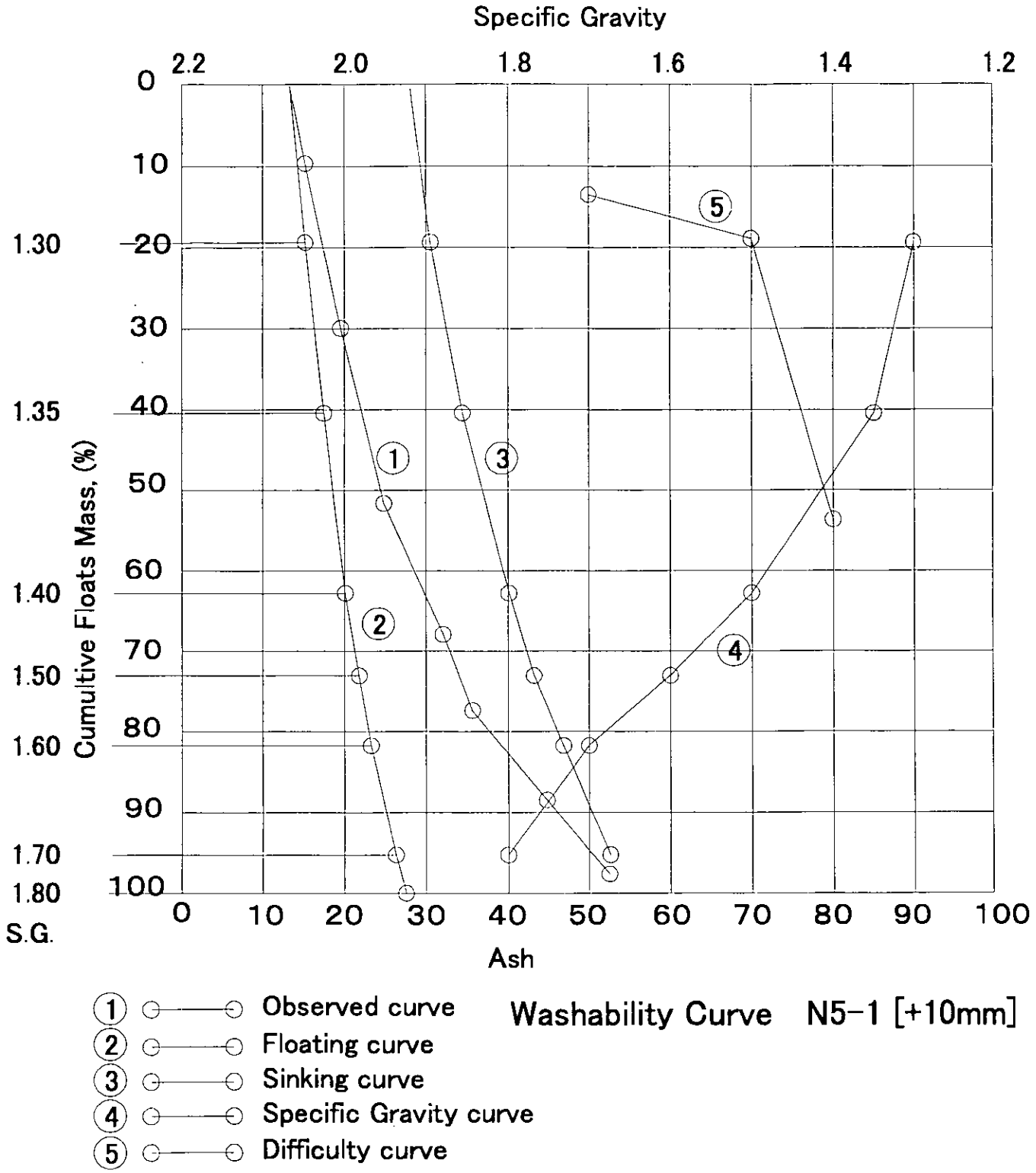

① Observed curve
② Floating curve
③ Sinking curve
④ Specific Gravity curve
⑤ Difficulty curve

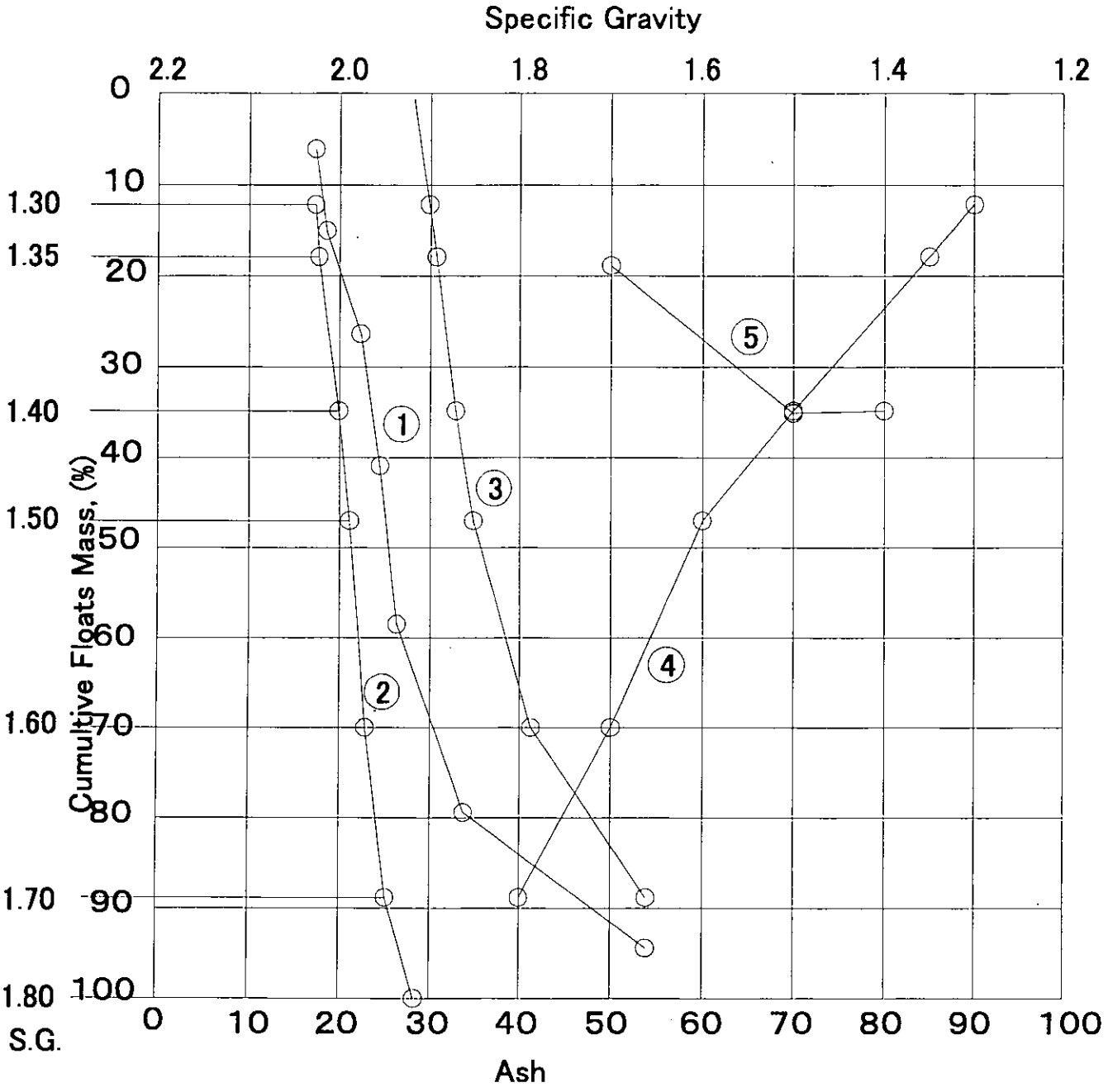
Washability Curve N3-6 [+10mm]




Washability Curve N3-6 [-10mm - +5mm]

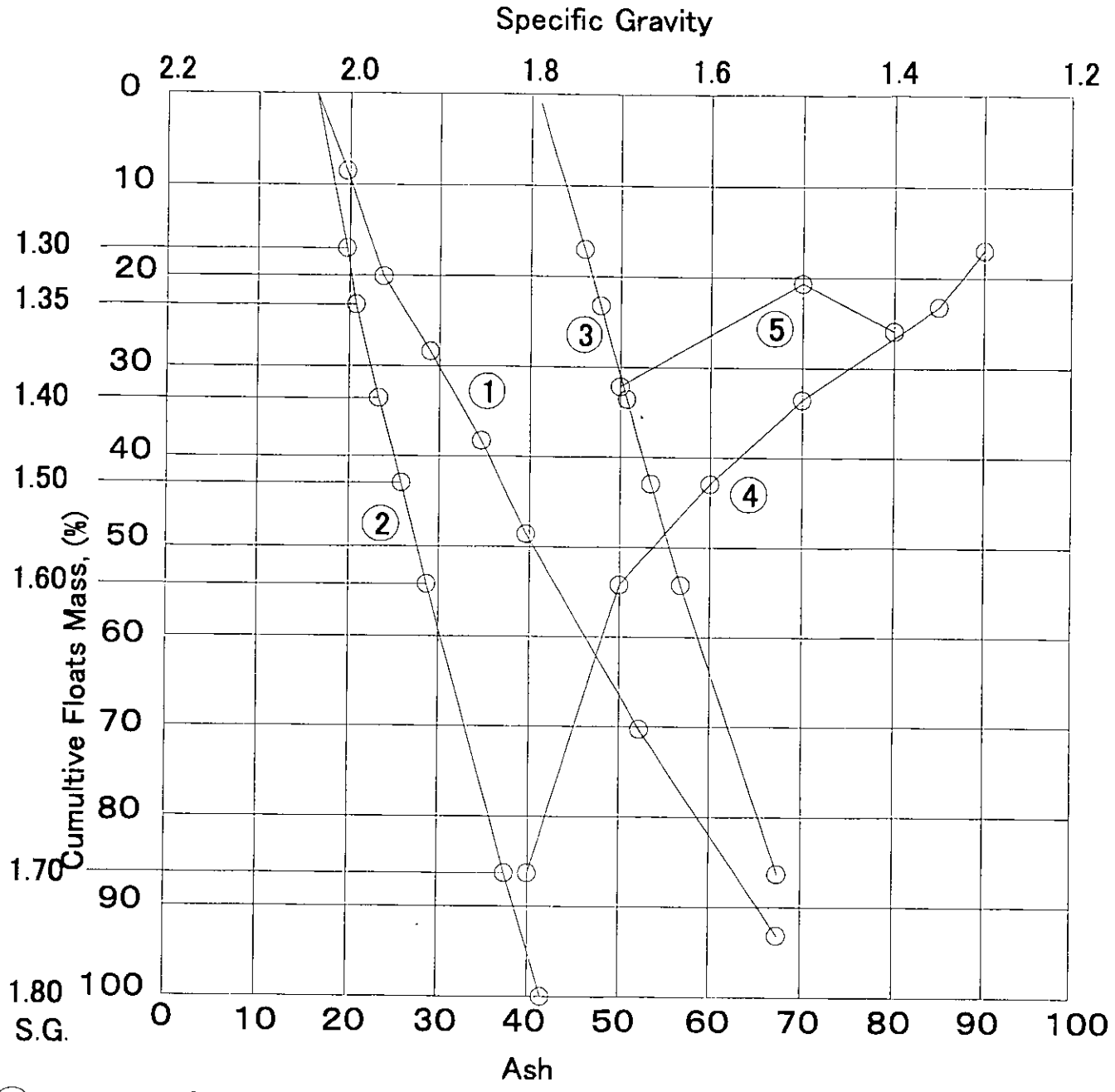
① Observed curve
② Floating curve
③ Sinking curve
④ Specific Gravity curve
⑤ Difficulty curve


Specific Gravity
2.2
2.0
1.8
1.6
1.4
1.2
0
10
20
30
40
50
60
70
80
90
100
1.30
1.35
1.40
1.50
1.60
1.70
1.80
S.G.
Cumulitive Floats Mass, (%)
0
10
20
30
40
50
60
70
80
90
100
Ash
①
②
③
④
⑤
① Observed curve
② Floating curve
③ Sinking curve
④ Specific Gravity curve
⑤ Difficulty curve
Washability Curve N5-1 [+10mm]



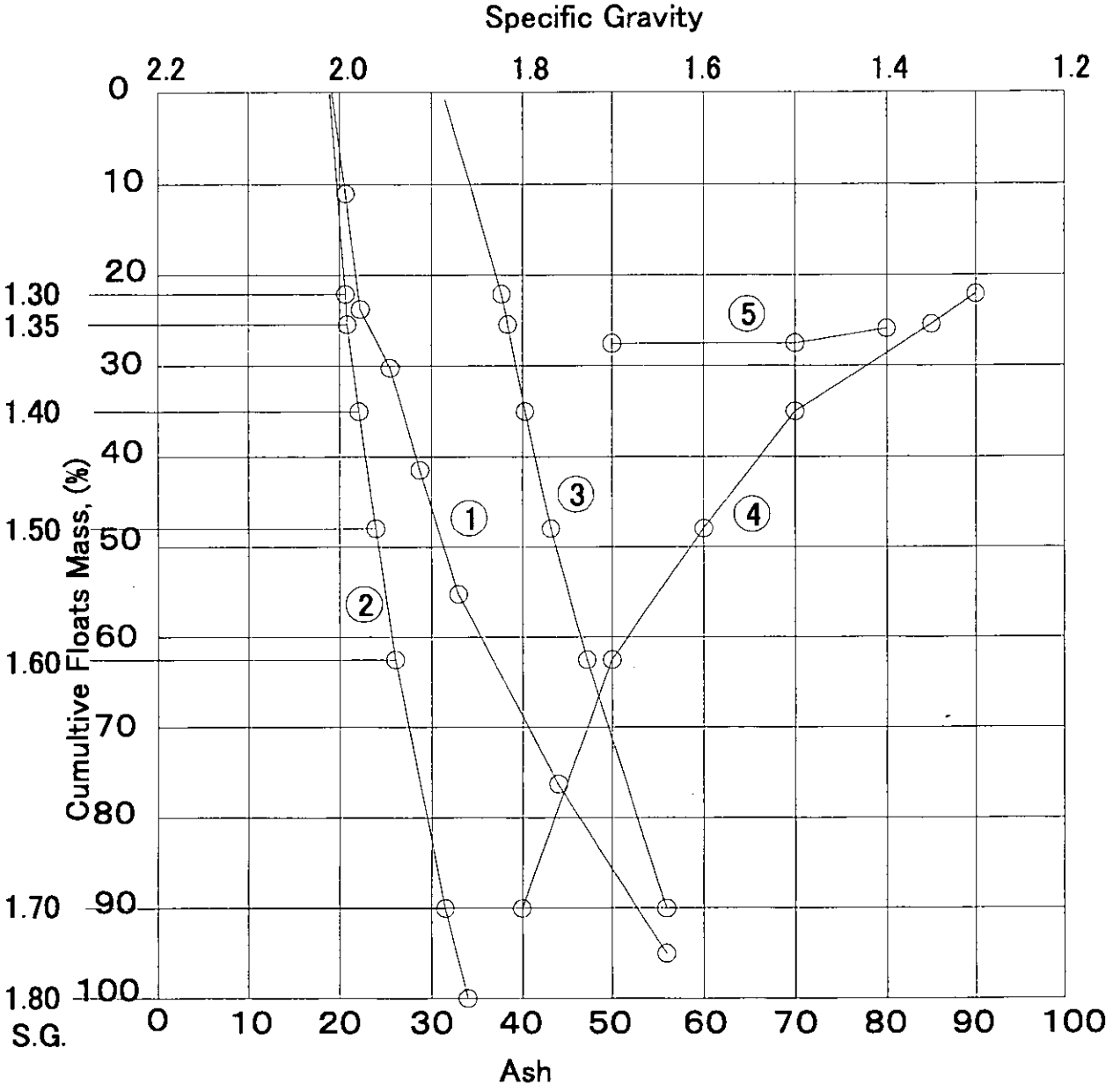

Washability Curve N5-1 [-10mm - +5mm]

① Observed curve
② Floating curve
③ Sinking curve
④ Specific Gravity curve
⑤ Difficulty curve




① Observed curve
② Floating curve
③ Sinking curve
④ Specific Gravity curve
⑤ Difficulty curve

Washability Curve N5-13 [+10mm]

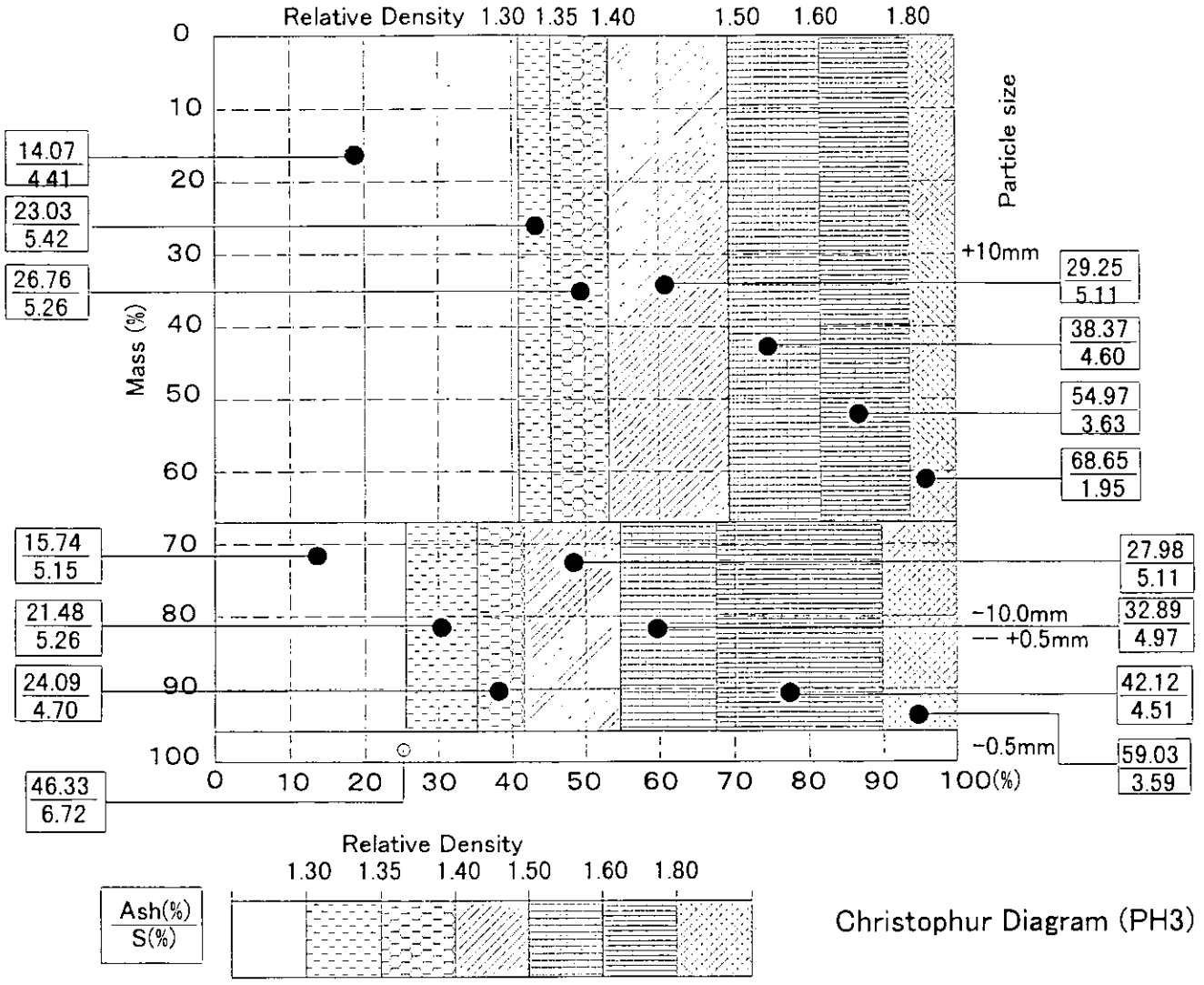



Washability Curve N5-13 [-10mm - +5mm]

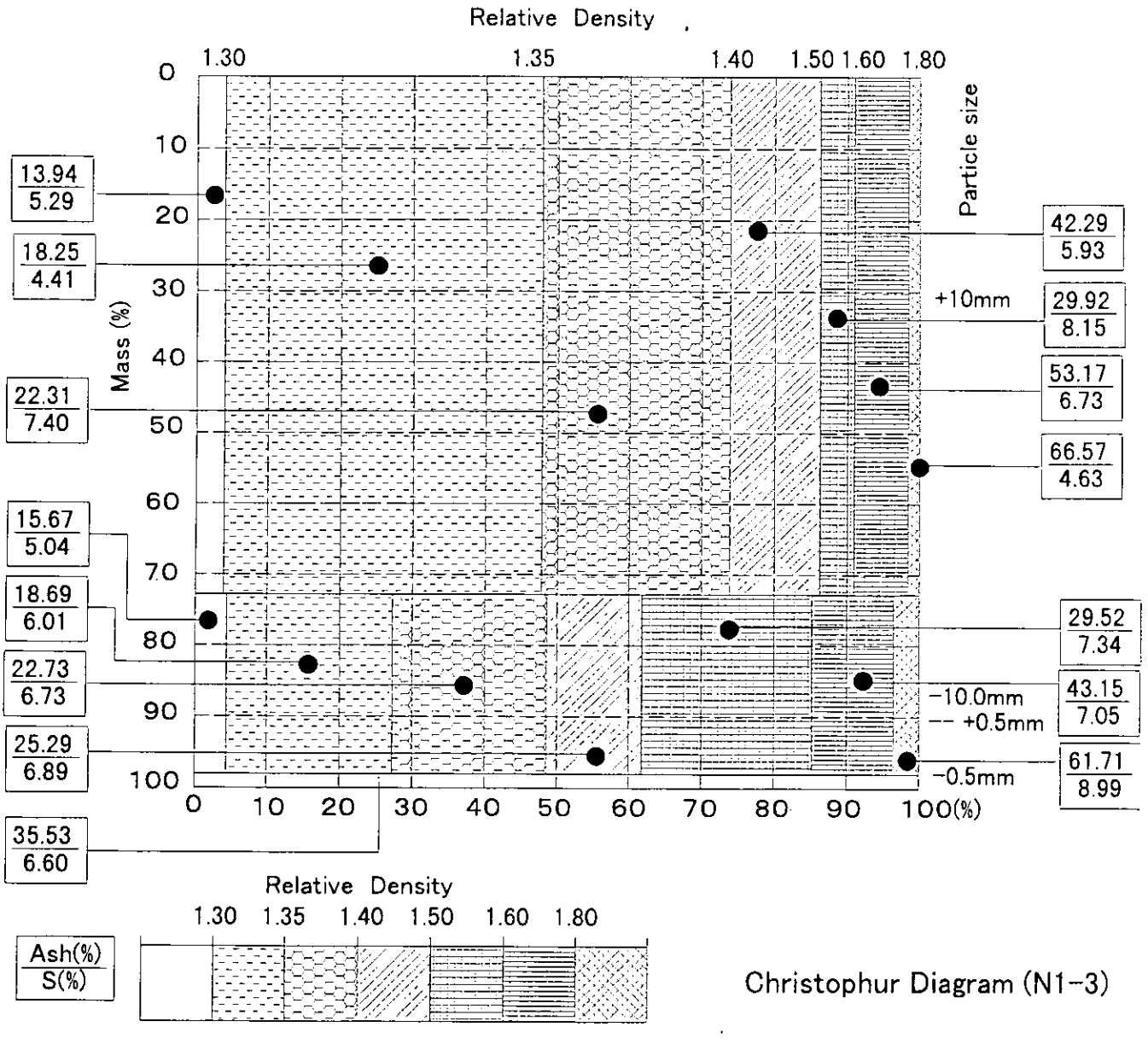
① Observed curve
② Floating curve
③ Sinking curve
④ Specific Gravity curve
⑤ Difficulty curve

# APPENDIX– 7

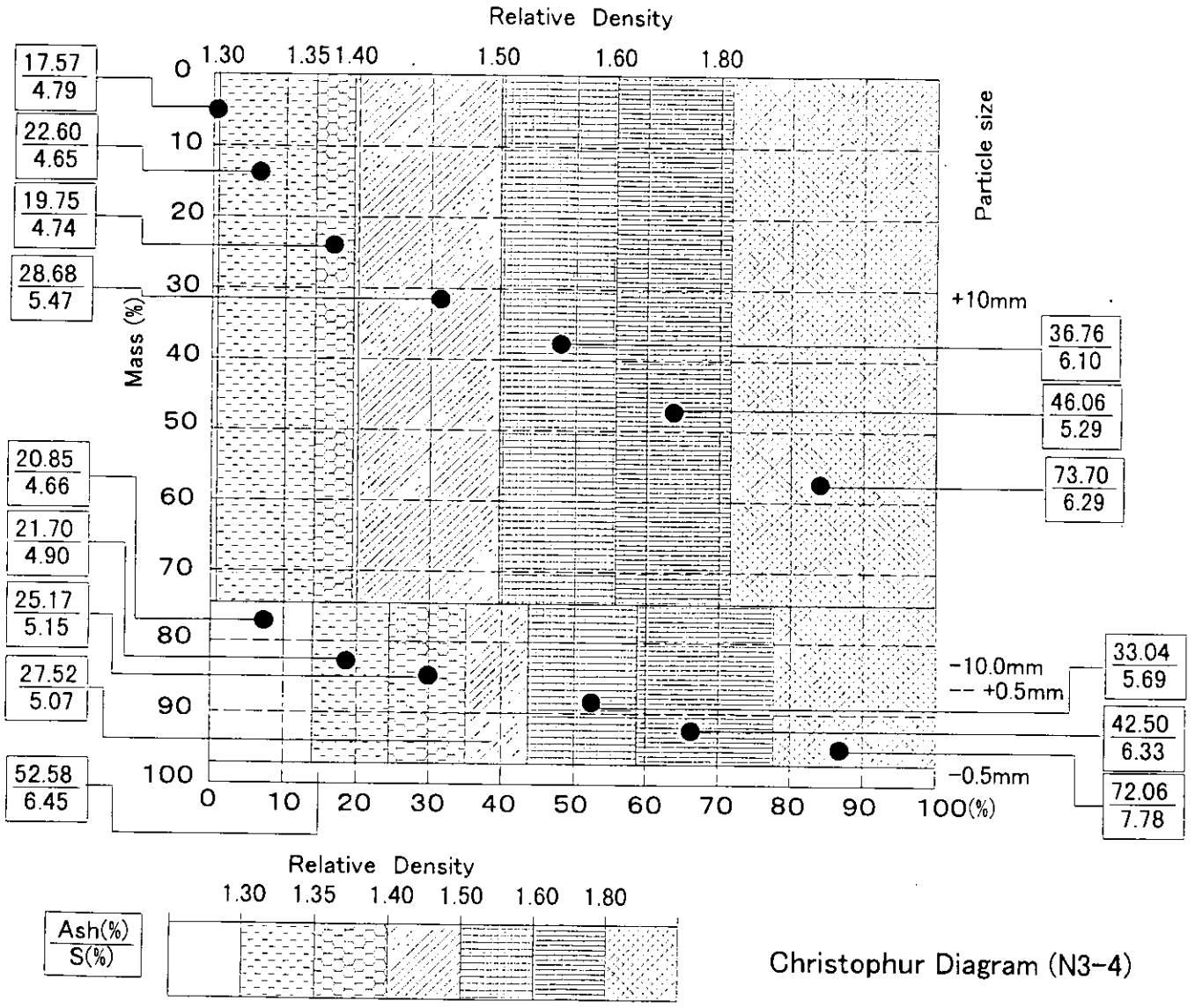
## Christpher Diagram on Bulk and Core Sample



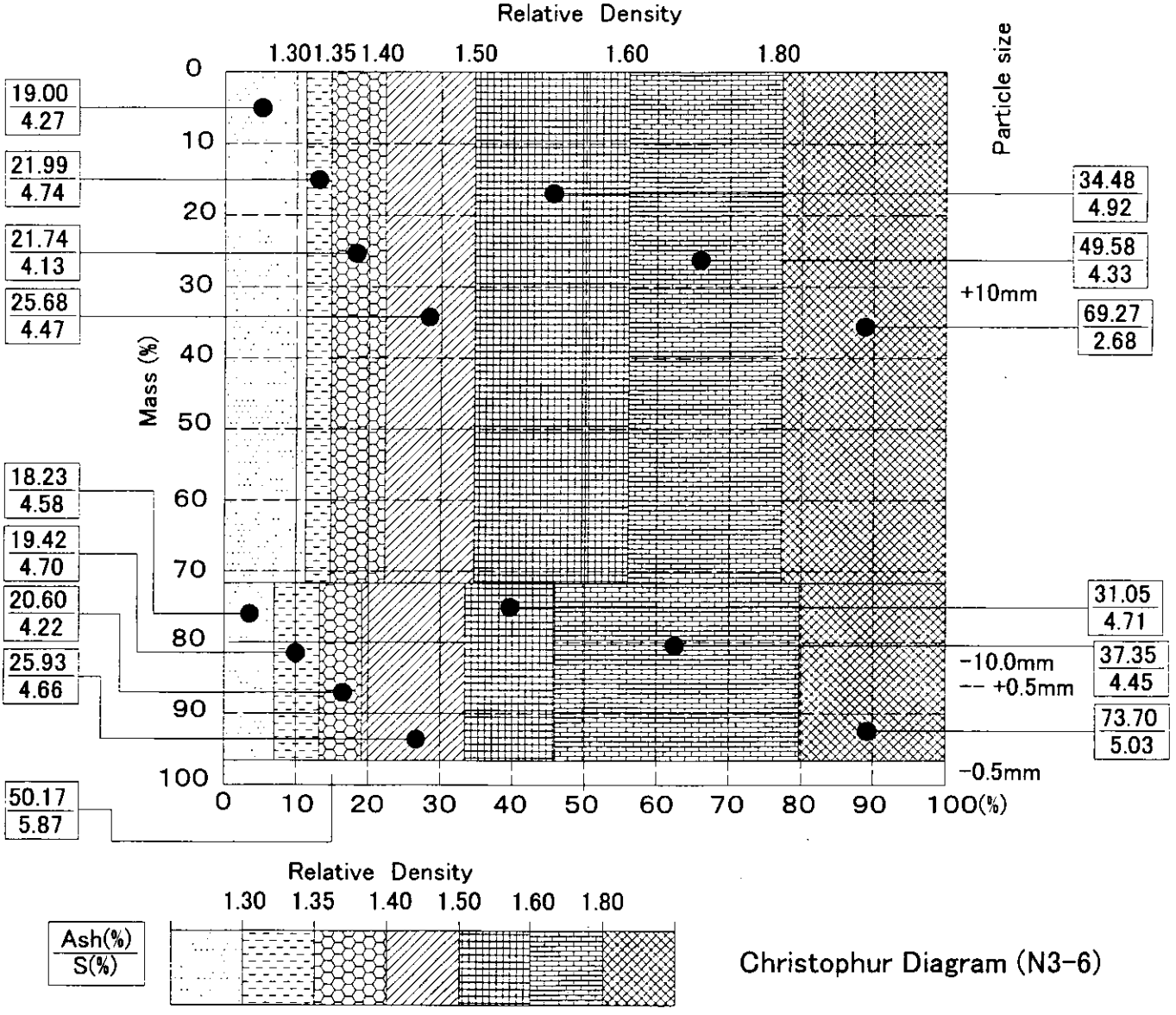

Christophur Diagram (PH3)




Christophur Diagram (N1-3)



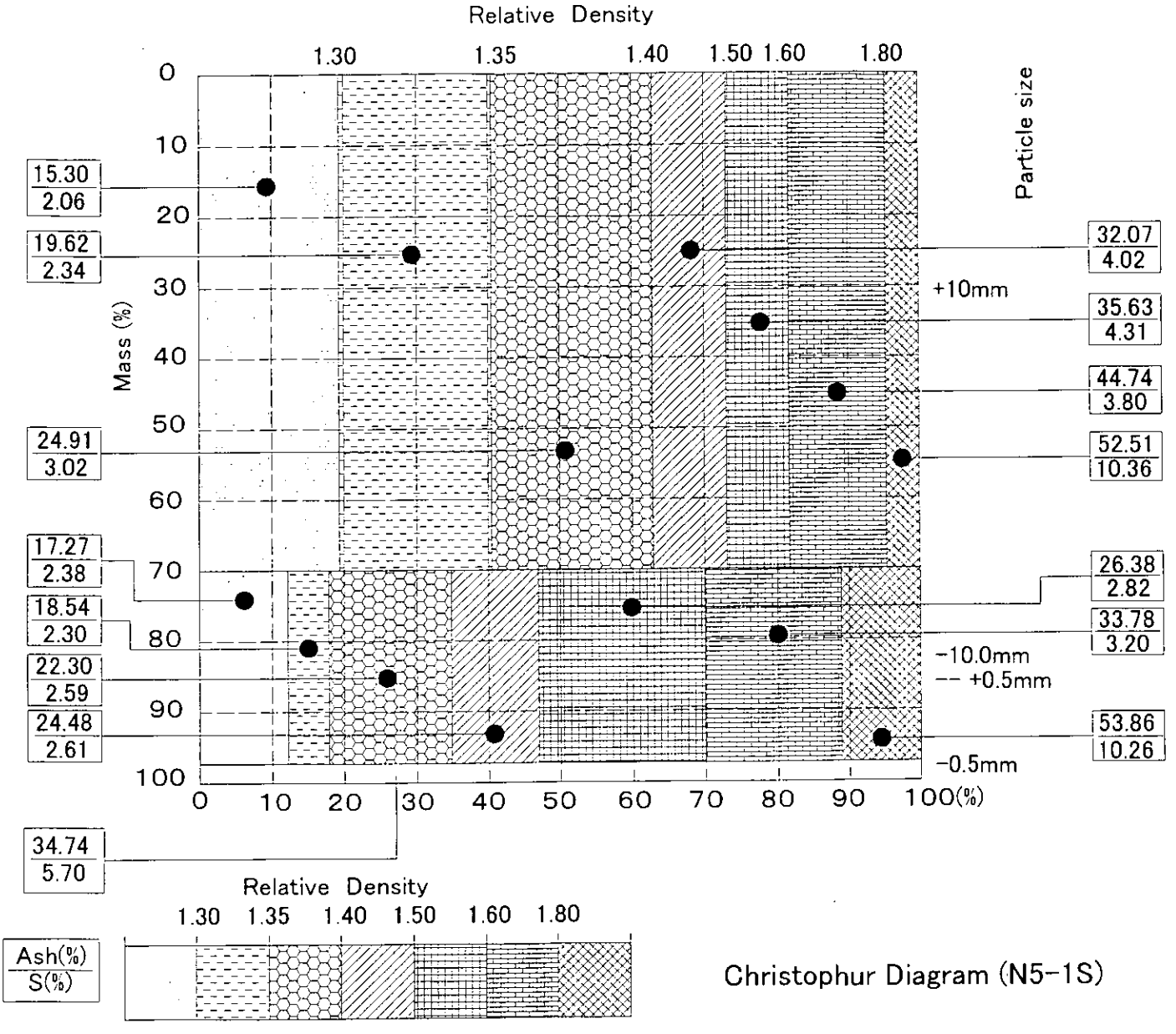

Christophur Diagram (N3-4)



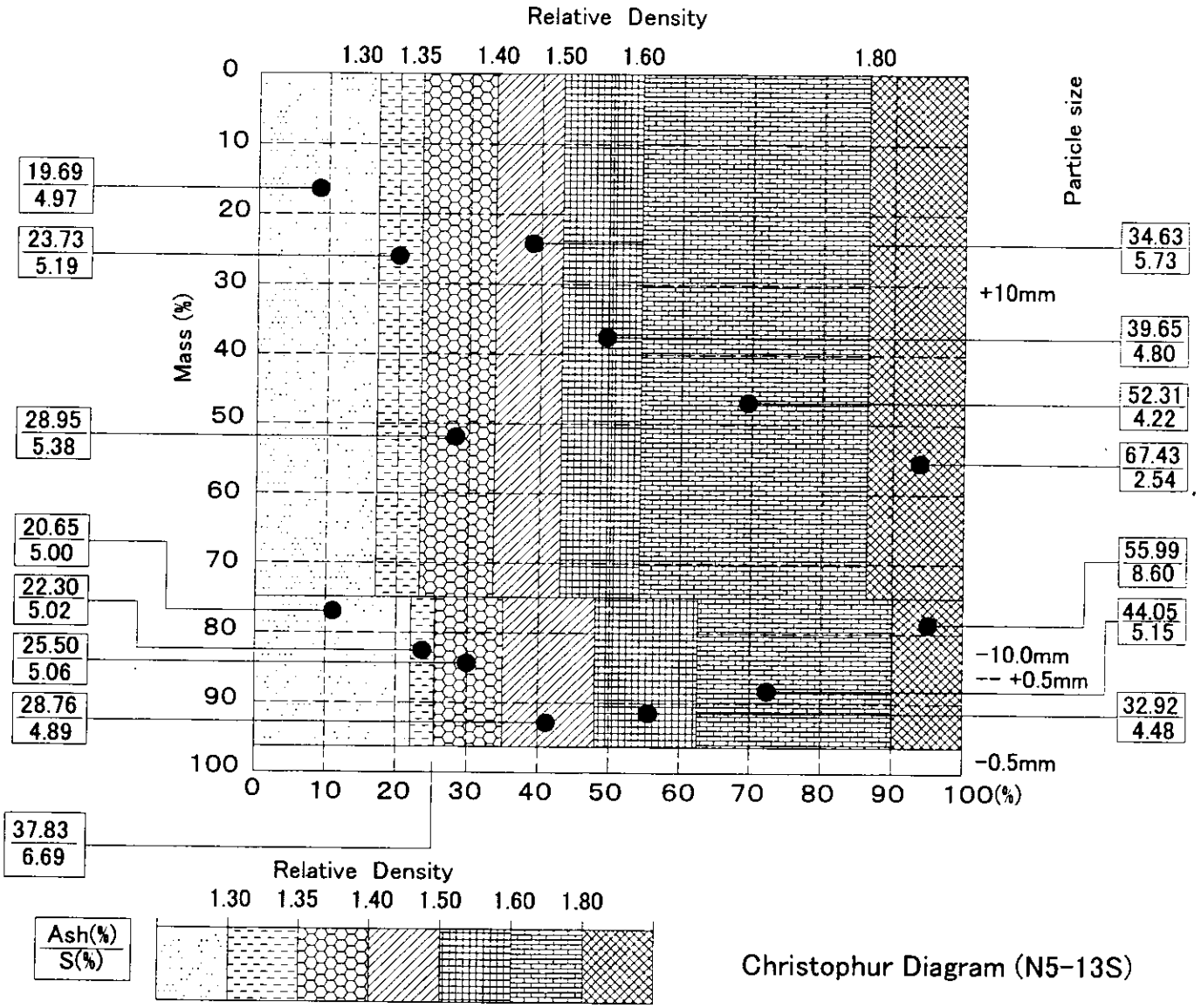




Christophur Diagram (N3-6)




Christophur Diagram (N5-1S)




Christophur Diagram (N5-13S)

# APPENDIX－８

## Form of Sulfur Analysis Result on Bulk Sample

SOURCE : Mitsubishi Materials Natural Resources Development Corp. (TOKYO, JAPAN)
BORE NO : B: Size 3.0 ~ 10.0 mm.
CHEMIST: .....

| | LAB NO. | | 01-CE84 | 01-CE85 | 01-CE86 | 01-CE87 |
|---|---|---|---|---|---|---|
| | SAMPLE NAME. | | B:3.0~10.0 mm 1.80S | B:3.0~10.0 mm 1.30F | B:3.0~10.0 mm, 1.35F | B:3.0~10.0 mm, 1.40F |
| | DATE OF RECEIVED | | 2001/12/9 | 2001/2/2 | 2001/2/2 | 2001/2/2 |
| | DATE OF ANALYSIS | | 2001/12/11 | 2001/2/6 | 2001/2/6 | 2001/2/6 |
| | FORMS OF SULPHUR | | | | | |
| AS ANALYSED BASIS | INHERENT MOISTURE | (%) | - | - | - | - |
| | TOTAL SULPHUR | (%) | - | - | - | - |
| | SULPHATE SULPHUR | (%) | 0.55 | 0.23 | 0.14 | 0.22 |
| | PYRITIC SULPHUR | (%) | 2.48 | 1.65 | 2.17 | 2.17 |
| | ORGANIC SULPHUR | (%) | 2.63 | 4.66 | 4.39 | 3.98 |
| DRY BASIS | TOTAL SULPHUR | (%) | - | - | - | - |
| | SULPHATE SULPHUR | (%) | - | - | - | - |
| | PYRITIC SULPHUR | (%) | - | - | - | - |
| | ORGANIC SULPHUR | (%) | - | - | - | - |

Remark : The results relate only to the sample(S) tested. This document shall no be reproduced except in full.
* Organic= Total Sulphur - (Sulphate + Py

SOURCE : Mitsubishi Materials Natural Resources Development Corp. (TOKYO, JAPAN)
BORE NO : B: Size 3.0 ~ 10.0 mm.
CHEMIST: .....

| | LAB NO. | | 01-CE88 | 01-CE89 | 01-CE90 | 01-CE91 |
|---|---|---|---|---|---|---|
| | SAMPLE NAME. | | B:3.0~10.0 mm, 1.50F | B:3.0~10.0 mm, 1.60F | B:3.0~10.0 mm, 1.70F | B:3.0~10.0 mm, 1.80F |
| | DATE OF RECEIVED | | 2001/12/9 | 2001/2/2 | 2001/12/9 | 2001/2/2 |
| | DATE OF ANALYSIS | | 2001/12/11 | 2001/2/6 | 2001/12/11 | 2001/2/6 |
| | FORMS OF SULPHUR | | | | | |
| AS ANALYSED BASIS | INHERENT MOISTURE | (%) | - | - | - | - |
| | TOTAL SULPHUR | (%) | - | - | - | - |
| | SULPHATE SULPHUR | (%) | 0.32 | 0.29 | 0.21 | 0.24 |
| | PYRITIC SULPHUR | (%) | 1.83 | 2.51 | 3.18 | 3.30 |
| | ORGANIC SULPHUR | (%) | 3.49 | 3.52 | 3.97 | 3.49 |
| DRY BASIS | TOTAL SULPHUR | (%) | - | - | - | - |
| | SULPHATE SULPHUR | (%) | - | - | - | - |
| | PYRITIC SULPHUR | (%) | - | - | - | - |
| | ORGANIC SULPHUR | (%) | - | - | - | - |

Remark : The results relate only to the sample(S) tested. This document shall no be reproduced except in full.
* Organic= Total Sulphur - (Sulphate + Pyriti

SOURCE : Mitsubishi Materials Natural Resources Development Corp. (TOKYO, JAPAN)
BORE NO : B: Size 25.0 ~ 50.0 mm.
CHEMIST: .....

| | LAB NO. | | 01-CE100 | 01-CE101 | 01-CE102 |
|---|---|---|---|---|---|
| | SAMPLE NAME. | | B:25.0~50.0mm. 1.30F | B:25.0~50.0mm. 1.35F | B:25.0~50.0mm. 1.40F |
| | DATE OF RECEIVED | | 2001/12/9 | 2001/12/9 | 2001/12/9 |
| | DATE OF ANALYSIS | | 2001/12/11 | 2001/12/11 | 2001/12/11 |
| | FORMS OF SULPHUR | | | | |
| AS ANALYSED BASIS | INHERENT MOISTURE | (%) | - | - | - |
| | TOTAL SULPHUR | (%) | - | - | - |
| | SULPHATE SULPHUR | (%) | 0.26 | 0.23 | 0.30 |
| | PYRITIC SULPHUR | (%) | 1.49 | 2.32 | 2.60 |
| | ORGANIC SULPHUR | (%) | 3.66 | 3.71 | 3.54 |
| DRY BASIS | TOTAL SULPHUR | (%) | - | - | - |
| | SULPHATE SULPHUR | (%) | - | - | - |
| | PYRITIC SULPHUR | (%) | - | - | - |
| | ORGANIC SULPHUR | (%) | - | - | - |

Remark : The results relate only to the sample(S) tested. This document shall no be reproduced except in full.
* Organic= Total Sulphur - (Sulphate + Pyritic)

SOURCE : Mitsubishi Materials Natural Resources Development Corp. (TOKYO, JAPAN)
BORE NO : B: Size 25.0 ~ 50.0 mm.
CHEMIST: .....

| | LAB NO. | | 01-CE104 | 01-CE105 | 01-CE106 |
|---|---|---|---|---|---|
| | SAMPLE NAME. | | B:25.0~50.0mm. 1.60F | B:25.0~50.0mm 1.70F | B:25.0~50.0mm. 1.80F |
| | DATE OF RECEIVED | | 2001/12/9 | 2001/12/9 | 2001/12/9 |
| | DATE OF ANALYSIS | | 2001/12/11 | 2001/12/11 | 2001/12/11 |
| | FORMS OF SULPHUR | | | | |
| AS ANALYSED BASIS | INHERENT MOISTURE | (%) | - | - | - |
| | TOTAL SULPHUR | (%) | - | - | - |
| | SULPHATE SULPHUR | (%) | 0.74 | 0.18 | 0.14 |
| | PYRITIC SULPHUR | (%) | 3.09 | 1.97 | 1.79 |
| | ORGANIC SULPHUR | (%) | 2.24 | 1.84 | 1.33 |
| DRY BASIS | TOTAL SULPHUR | (%) | - | - | - |
| | SULPHATE SULPHUR | (%) | - | - | - |
| | PYRITIC SULPHUR | (%) | - | - | - |
| | ORGANIC SULPHUR | (%) | - | - | - |

Remark : The results relate only to the sample(S) tested. This document shall no be reproduced except in full.
* Organic= Total Sulphur - (Sulphate + Pyritic)

SOURCE : Mitsubishi Materials Natural Resources Development Corp. (TOKYO, JAPAN)
BORE NO : B: Size 0.5 ~ 3.0 mm.
CHEMIST: .....

| | LAB NO. | | 01-CE82 | 01-CE83 |
|---|---|---|---|---|
| | SAMPLE NAME. | | B:0.5 ~3.0 mm, 1.70F | B:0.5 ~3.0 mm, 1.80F |
| | DATE OF RECEIVED | | 2001/12/9 | 2001/12/9 |
| | DATE OF ANALYSIS | | 2001/12/11 | 2001/12/11 |
| AS ANALYSED BASIS | FORMS OF SULPHUR | | | |
| | INHERENT MOISTURE | (%) | - | - |
| | TOTAL SULPHUR | (%) | - | - |
| | SULPHATE SULPHUR | (%) | 0.03 | 0.20 |
| | PYRITIC SULPHUR | (%) | 1.19 | 2.65 |
| | ORGANIC SULPHUR | (%) | 3.26 | 4.21 |
| DRY BASIS | TOTAL SULPHUR | (%) | - | - |
| | SULPHATE SULPHUR | (%) | - | - |
| | PYRITIC SULPHUR | (%) | - | - |
| | ORGANIC SULPHUR | (%) | - | - |

Remark : The results relate only to the sample(S) tested. This document shall no be reproduced except in full.
* Organic= Total Sulphur - (Sulphate + Pyritic

SOURCE : Mitsubishi Materials Natural Resources Development Corp. (TOKYO, JAPAN)
BORE NO : B Series
CHEMIST: .....

| | LAB NO. | | 01-CE96 | 01-CE97 | 01-CE98 |
|---|---|---|---|---|---|
| | SAMPLE NAME. | | B:10.0~25.0 mm, 1.50F | B:10.0~25.0 mm, 1.60F | B:10.0~25.0 mm, 1.70F |
| | DATE OF RECEIVED | | 2001/12/9 | 2001/12/9 | 2001/12/9 |
| | DATE OF ANALYSIS | | 2001/12/11 | 2001/12/11 | 2001/12/11 |
| AS ANALYSED BASIS | FORMS OF SULPHUR | | | | |
| | INHERENT MOISTURE | (%) | - | - | - |
| | TOTAL SULPHUR | (%) | - | - | - |
| | SULPHATE SULPHUR | (%) | 0.43 | 0.40 | 0.19 |
| | PYRITIC SULPHUR | (%) | 2.97 | 3.57 | 3.02 |
| | ORGANIC SULPHUR | (%) | 3.80 | 3.87 | 2.94 |
| DRY BASIS | TOTAL SULPHUR | (%) | - | - | - |
| | SULPHATE SULPHUR | (%) | - | - | - |
| | PYRITIC SULPHUR | (%) | - | - | - |
| | ORGANIC SULPHUR | (%) | - | - | - |

Remark : The results relate only to the sample(S) tested. This document shall no be reproduced except in full.
* Organic= Total Sulphur - (Sulphate + Pyritic)

SOURCE : Mitsubishi Materials Natural Resources Development Corp. (TOKYO, JAPAN)
BORE NO : B: Size 0.5 ~ 3.0 mm.
CHEMIST: .....

| | LAB NO. | | 01-CE78 | 01-CE79 | 01-CE80 |
|---|---|---|---|---|---|
| | SAMPLE NAME. | | B:0.5 ~3.0 mm, 1.80S | B:0.5 ~3.0 mm, 1.35F | B:0.5 ~3.0 mm, 1.50F |
| | DATE OF RECEIVED | | 2001/12/9 | 2001/12/9 | 2001/12/9 |
| | DATE OF ANALYSIS | | 2001/12/11 | 2001/12/11 | 2001/12/11 |
| | FORMS OF SULPHUR | | | | |
| AS ANALYSED BASIS | INHERENT MOISTURE | (%) | - | - | - |
| | TOTAL SULPHUR | (%) | - | - | - |
| | SULPHATE SULPHUR | (%) | 0.74 | 0.08 | 0.50 |
| | PYRITIC SULPHUR | (%) | 3.59 | 1.11 | 0.95 |
| | ORGANIC SULPHUR | (%) | 3.39 | 4.55 | 3.10 |
| DRY BASIS | TOTAL SULPHUR | (%) | - | - | - |
| | SULPHATE SULPHUR | (%) | - | - | - |
| | PYRITIC SULPHUR | (%) | - | - | - |
| | ORGANIC SULPHUR | (%) | - | - | - |

Remark : The results relate only to the sample(S) tested. This document shall no be reproduced except in full.
* Organic= Total Sulphur - (Sulphate + Pyritic)

SOURCE : Mitsubishi Materials Natural Resources Development Corp. (TOKYO, JAPAN)
BORE NO : B: Size 10.0 ~ 25.0 mm.
CHEMIST: .....

| | LAB NO. | | 01-CE92 | 01-CE93 | 01-CE94 | 01-CE95 |
|---|---|---|---|---|---|---|
| | SAMPLE NAME. | | B:10.0~25.0 mm 1.80S | B:10.0~25.0 mm 1.30F | B:10.0~25.0 mm. 1.35F | B:10.0~25.0 mm. 1.40F |
| | DATE OF RECEIVED | | 2001/12/9 | 2001/12/9 | 2001/12/9 | 2001/12/9 |
| | DATE OF ANALYSIS | | 2001/12/11 | 2001/12/11 | 2001/12/11 | 2001/12/11 |
| | FORMS OF SULPHUR | | | | | |
| AS ANALYSED BASIS | INHERENT MOISTURE | (%) | - | - | - | - |
| | TOTAL SULPHUR | (%) | - | - | - | - |
| | SULPHATE SULPHUR | (%) | 0.43 | 0.28 | 0.30 | 0.25 |
| | PYRITIC SULPHUR | (%) | 1.79 | 1.41 | 2.13 | 2.60 |
| | ORGANIC SULPHUR | (%) | 1.62 | 3.83 | 4.42 | 4.08 |
| DRY BASIS | TOTAL SULPHUR | (%) | - | - | - | - |
| | SULPHATE SULPHUR | (%) | - | - | - | - |
| | PYRITIC SULPHUR | (%) | - | - | - | - |
| | ORGANIC SULPHUR | (%) | - | - | - | - |

Remark : The results relate only to the sample(S) tested. This document shall no be reproduced except in full.
* Organic= Total Sulphur - (Sulphate + Pyritic)

# APPENDIX－９

## Estimation of Upgrading Cost

## Estimation of Upgrading Cost

| | USA Base | Thailand Base | Thailand Base |
|---|---|---|---|
| Raw Materials Processed at Pl: | | | |
| (t/D) | 5,000 | 3,226 | 1,613 |
| (1000 t/Y) | 1,550 | 1,000 | 500 |
| Operation Days (D/Y) | 310 | 310 | 310 |
| Yield of Solid Product | 50 % | 50 % | 50 % |
| Yield of Liquid Product | 10 % | 10 % | 10 % |
| Plant Depreciation | 10 years | 10 years | 10 years |
| Money Rate | 5 % | 5 % | 5 % |

| | | USA Base | | Scale Facter | Local factor in Tailand | Scale Factor | Local factor in Tailand |
|---|---|---|---|---|---|---|---|
| | | | | 0.736 | 0.7 | 0.453 | 0.7 |
| | | M. $ | M. Baht | M. Baht | M. Baht | M. Baht | M. Baht |
| Capital Cost | | | | | | | |
| | Equipment Cost | 125 | 5,625 | 4,146 | 2,902 | 2,548 | 1,784 |
| | Money Rate | 37 | 1,665 | 1,227 | 859 | 754 | 528 |
| | Sub Total | 162 | 7,290 | 5,373 | 3,761 | 3,302 | 2,312 |
| Annual Cost | | 16.2 | 729 | 537 | 376 | 330 | 231 |
| | | | | | | | |
| Operating Cost | | 5 | 225 | 166 | 116 | 102 | 71 |
| | | | | | | | |
| Total Cost | Total (a) | 21.2 | 954 | 703 | 492 | 432 | 303 |

| | | | | | |
|---|---|---|---|---|---|
| Income Credit by Liquid Product | | | | | |
| Annual Liquid Product (b) | 0.155 | M.t | 0.100 | M.t | 0.050 | M.t |
| Unit Price: (16$/BLL) (c) | 100 | $/t | 4,500 | B/t | 4,500 | B/t |
| Total (d=b×c) | 15.5 | M.$/y | 450 | M.B/y | 225 | M.B/y |
| Total Cost after Income Credit(e=a-d) | 5.7 | M.$/y | 42 | M.B/y | 78 | M.B/y |
| Annual Solid Product (f) | 0.775 | M.t | 0.500 | M.t | 0.250 | M.t |
| Total Unit Cost of Solid Product(e/f) | 7.4 | $/t | 84 | B/t | 310 | B/t |

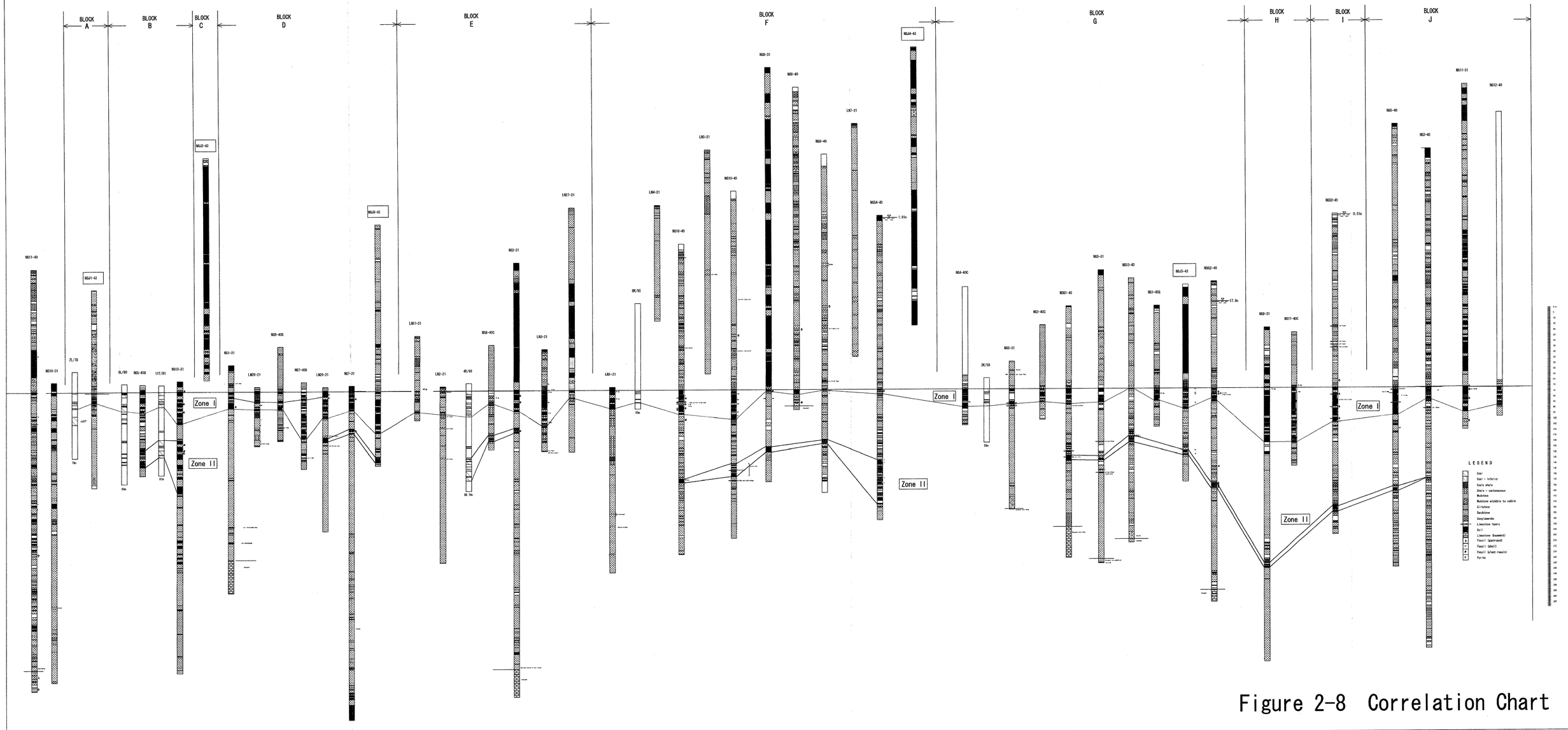



Figure 2-8 Correlation Chart