Specialist supplier of high performance metals and metallic compounds for over 35 years

Nickel Powders

Nickel metal and nickel containing alloys are essential materials used in a wide variety of technologies and applications. Elemental nickel, without any alloying additives, exhibits excellent mechanical properties, good resistance to corrosion, high electrical conductivity and ferro-magnetic properties. A further critical advantage of elemental nickel is that it is readily available as a high purity powder in different morphologies.

For many years Hart Materials has specialised in supplying nickel powders and consequently developed a comprehensive level of technical expertise related to these products. Furthermore the company has initiated studies into the properties of nickel powders thereby enabling it to provide technical information that has not previously been available. As a result the company is in a unique position to advise customers on the optimum choice of nickel powder available from a range of manufacturers.
Nickel Powders available from Hart Materials

Carbonyl nickel powders

The purest grades of nickel powder that are readily available in commercial quantities are manufactured to react with carbon monoxide to form nickel tetra carbonyl. The extremely pure gaseous Ni(CO)₄ is

Spherical Vale Carbonyl Nickel - Type 123

The specified nickel content of Vale Type 123 carbonyl nickel powder - 99.98% nickel - represent the highest level of purity available in regular commercial production. It is manufactured in very large quantities and is not merely a special grade with limited production.

Vale Nickel Powder Type 123 has been the backbone of nickel powder technology for decades. The product consists of discrete, approximately spherical, particles with a tightly controlled and consistently reproducible particle size distribution. It is used extensively in the production of powder metallurgical parts and in synthesis of synthetic diamonds. It is also the primary binder, together with carbonyl iron powder, used in the manufacture of Tungsten Heavy Alloy components used primarily for medical, defence and aerospace applications.

Type 123 special Hart Materials’ grades

Hart Materials also offers a number of different size fractions of carbonyl nickel powders, all based on Vale Type 123, but available in four different size ranges.

Plus 325 mesh

Minus 325 mesh

-325 mesh - +20 microns

-20 micron

Filamentary Carbonyl Nickel Powders - Vale Nickel Type 255

Vale Type 255 carbonyl nickel powder consists of filamentary particles a completely different particle morphology, a completely different particle size distribution and the same high level of chemical purity as Vale 123.

The advantage of the filamentary structure is that it can be used to create an electrically conductive matrix in the construction of nickel-containing batteries where the nickel matrix acts as the carrier of the charge.

Type 255 is also the primary binder in nickel based tungsten carbide components used in steel cutting tools.

In addition Vale Type 255 nickel powder is also used in the manufacture of electrically conductive inks.
Novamet Specialty Products Corporation manufactures two highly refined grades of filamentary carbonyl nickel powder. These are designated Type 525 Regular and Type 525 Low Density. Since they are derived from material refined by the nickel carbonyl process they exhibit the same high purity as Vale Type 123 and Vale Type 255.

These two grades of filamentary carbonyl nickel powder are employed in similar applications to Vale 255, such as nickel battery manufacture and the production of electrically conductive coatings used in RFI/EMI shielding application.

**NOVAMET Type 525 Regular and Type 525 Low Density**

Novamet Specialty Products Corporation manufactures two highly refined grades of filamentary carbonyl nickel powder. These are designated Type 525 Regular and Type 525 Low Density. Since they are derived from material refined by the nickel carbonyl process they exhibit the same high purity as Vale Type 123 and Vale Type 255.

These two grades of filamentary carbonyl nickel powder are employed in similar applications to Vale 255, such as nickel battery manufacture and the production of electrically conductive coatings used in RFI/EMI shielding application.

**NOVAMET Special Spherical Nickel Powders - Type 4SP and SNP**

Novamet Specialty Products Corporation manufactures five different grades of high purity smooth spherical nickel powders produced, not by the carbonyl process, but by gas atomisation.

**Novamet Type 4SP – 10 µm** powder at 5,000 times magnification demonstrates the precise spherical nature of the 4SP/SNP particles and the smoothness of their surfaces. This morphology accounts for the very high values of Tapped Density of these products.

The typical chemical composition of all of this range of powders is:

<table>
<thead>
<tr>
<th>Element</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ni</td>
<td>99.6%</td>
</tr>
<tr>
<td>O</td>
<td>3,000 ppm</td>
</tr>
<tr>
<td>Fe</td>
<td>800 ppm</td>
</tr>
<tr>
<td>C</td>
<td>30 ppm</td>
</tr>
<tr>
<td>S</td>
<td>30 ppm</td>
</tr>
</tbody>
</table>

There are four separate grades available of this type of nickel powder with typical physical properties as shown below.

<table>
<thead>
<tr>
<th>Grade</th>
<th>d10</th>
<th>d50</th>
<th>d90</th>
<th>Tapped Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNP – 400</td>
<td>4.4µm</td>
<td>11.4µm</td>
<td>25.2µm</td>
<td>5.57</td>
</tr>
<tr>
<td>4SP – 10 µm</td>
<td>3.0 µm</td>
<td>6.3 µm</td>
<td>11.2 µm</td>
<td>5.48</td>
</tr>
<tr>
<td>SNP -20/+10 µm</td>
<td>7.2 µm</td>
<td>11.4 µm</td>
<td>17.1 µm</td>
<td>5.45</td>
</tr>
<tr>
<td>SNP + 20 µm</td>
<td>12.6 µm</td>
<td>20.8 µm</td>
<td>34.6 µm</td>
<td>5.37</td>
</tr>
</tbody>
</table>

The microstructure of the nickel powders is porous, rather than compact. The particles are spherical in shape and have a smooth surface and are free from dust. This morphology provides a conductive matrix into which other materials can be introduced. This is a vital part of the coating process for the electrons generated by the active mass.

It is used in the manufacture of el rollers, canning dies and in fluid flow control situations in the oil and gas industries. It is also used in conductive paints for electromagnetic compatibility applications.
Nickel Powders available from Hart Materials

Chemically reduced Nickel Powders
Hart Materials also supplies a number of nickel powders manufactured by chemical reduction from high purity nickel salts.

**Hart Type 1A powder**, as shown below, is a very fine material with a d50 in the region of 3 microns.

**Hart Type 1A nickel powder**

Hart Materials type 2A, nickel powder has a slightly larger particle size than the Type 1A with a d50 of around 6 microns.

**Hart Type 2A nickel powder**

Hart Materials Type 3A, has the largest particle size of the special chemically reduced nickel powders with a D50 in the region of 15 microns.

**Hart Materials Type 3A**

Material choice
The wide choice of nickel powders offered by Hart Materials gives our customers considerable flexibility in relation to chemical composition, particle size and morphology.

Nickel powders have many on-going traditional applications. The range and type of industries in which they are being used, however, is constantly expanding as their many advantages in terms of metallurgical properties, chemical stability electrical conductivity are being exploited in new and developing technologies.

Hart Materials endeavours to offer as wide a range as possible of nickel powders to suit the requirements of individual customers and applications.

Hart Materials also invites enquiries in relation to non-standard types of nickel powder not included in our current product range.

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