Ok, Let's start with the standard information for the filament Type 021N

**Identification:**
Relatively large, non-motile filaments (100->1000 µm). Straight or smoothly curved, sometimes coiled filaments with no branching. Characteristic looping seen. Filaments taper from a thick basal region, and often exhibit a holdfast to a thinner apical region, terminating in a loosely attached gonidia (a distinctive rod-shaped cell at the trichome end). Rosettes are observed infrequently. Rosettes are when many filaments radiate outward from a common origin. The cell septa are very clear with indentations. Cells are very irregular, large and usually square but can vary from disc, ovoid, rod or barrel shaped, sometimes even in the same filament (1.0-2.0 µm). Filaments are found within the floc structure and the bulk solution when in rapid growth stage. The filament staining is usually Gram negative and Neisser negative with Neisser positive granules. Can be Gram positive when sulfur granules are present. Usually easy to identify due to its irregular shaped cells. There is no sheath, although a heavy cell wall will remain after cell lysis with chlorination. There may be intracellular sulfur granules and often responds to S-tests. Poly-ß-hydroxybutric acid (PHB) granules are frequently observed as dark intracellular granules. No attached growth.

**Similar Organisms:**
At least five other organisms can be mistaken for this filament because of its variable cell shape, *Thiothrix* or Type 0041 especially.

**Environment:**
This filament is usually found in environments where there are septic wastes, or wastes with sulfides or organic wastes, N deficient wastes and low F/M when the waste is composed of simple sugars or organic acids. Grows readily in food processing, wet corn milling, brewing and malting, fish processing petrochemicals and pulp and paper mills.

**Control:**
If the S test is positive, the cause is septic wastes or presence of sulfides and can be remedied by pre-aeration or pre-chlorination. Nitrogen deficient wastes can be checked by effluent values of residual NH3 and should be supplemented. F/M can be changed by use of a selector. Chlorination should be definitely used if in the rapid growth phase.

**Rank:**
Type 021N ranks 3rd in number of predominance. (SVI values can exceed 500 mg/l) Rapid growth of this filament can cause
severe settling problems in only a few days. Now, let’s see if we can figure out the easiest way to identify this filament.

It is actually an easy filament to identify. It is very large, and usually sticks out of the floc structures compared to many other filaments that like to be more internal. You can see from the photo below, that if left along, it can cause serious bridging problems.

Let’s take a closer look

The filament appears relatively flat, and will have ribbon like twists, so you will have to move your focus knob in and out to see the cells on occasion. See how it is twisting on the slide to the left. Notice how long and large the filament is compared to the smaller one embedded in the floc structures.

Let your slide dry out almost to the point of being too long, this is the easiest way to see Type 021N and is will lay nicely on the slide, appear to enlarge the cells and more of the details will be sharper.

Again, notice how large it is. There are only a few other non-motile filaments that appear as large as this, 0041 and Thiothrix and they both have a sheath, so that is easy to narrow it down if it is a relatively large, long filament.
It can have many different looks, even in the same sample, so do not get worried if all the cells and filaments do not look alike. That is one of the quirks about Type 021N.

Notice the white spots on each of the cells—this is common on Gram stains of Type 021N and is an easy telltale sign if present that you have Type 021N.
Here you can see Type 1851 off to the right with the small, periodic attached growth, type 0041 is on the tom with heavy attached growth and type 021N is the large, flat filament with rounded, irregular shaped cells on the bottom. Notice the difference in size, and width of the cells.
Again, here you have N. limicola is the purple filament on the lower left, 1851 is the small filament to the very left, 0041 is in the top right with heavy attached growth and 021N is the largest in the photo. Notice how none of the cells are uniform. Some are small, some larger, some bulging out of the side of the filament.

Here again, the cells change shape even in the same filament.
Lacto-Phenol cotton blue helps to bring out the cell shapes on a wet mount.

In this photo, 021N is beside a cluster of fingered zooglea. Notice how it is very hard to get the entire filament in focus. That is due to the fact that this filament many times will twist and turn like a ribbon.
It is always one of the largest filaments. Here you can see how it twists and turns.

In many industrial plants, if in a high growth phase, it will have very rectangular, elongated cells if in a very high growth phase. Here it looks completely different than many of the photos above, yet there is no sheath, and the telltale white spots in the center of the cells help to give it away.
O21N is often found where there are septic conditions. Sulfur granules will appear on the filament if septicity is high. You can also see spirillum in this photo. An instant give away that somewhere you are holding things too long. It may be in an EQ tank, a primary clarifier, a secondary clarifier and you are holding the solids too long there, or sometimes we have seen a digestor that they turn off the air for too long while trying to decant.
Again white spots on the filament. See the spiral bacteria in the upper right corner. Always a dead give away that septic conditions are occurring somewhere.

Sulfur granules will glow and have dark spots also. It is easy to pick out on a filament. It may remind you of pepper being sprinkled on something.
Notice how the filament twists and turns like a ribbon.

Sometimes the tip of the cell will have a Gonidia. Gonidia is the detachment of single cells from the ends of the filaments. They are typically oval or rod shaped cells that appear different in shape from the rest of the normal cells on the filament.
Gonidia can also indicate that the filament is growing very rapidly, are in a nutrient deficient system or septicity is probably present. Here you can see the glow of the sulfur granules and you can see how the cells at the tip of the filament are different shaped than the cells further back on the filament.

This photo has type 021N as well as the small cluster of type 1863. It is easy to see the dotted sulfur granules along the length of the filament.
There can be different sizes of 021N in the same sample. Are these different strains of the same filament, or young vs. old versions of the same species? Does it matter? What really matters is that they are all caused by the same thing, all indicate the same thing and all require the same process changes to be made, so getting entirely technical will not change anything at the plant.

In this photo you can see mainly 021N, but you can see a vertical filament on N. Limicola. Notice how the N limicola has a more distinct shape and more spaces between the filament, so it is easier to see the individual cells. Also the cells are more rounded, or disc like and more stacked on the N. limicola.
Type 021N can grow extremely fast and take over a system quite quickly and cause serious bulking problems, so this filament should be monitored closely. It grows quite quickly in an industrial plant in a nutrient deficient system very fast and can cause serious problems. It tends to grow a bit slower when the cause is septicity.