

Quality assurance of μ -MIM

Compared to other metal component manufacturing processes, the metal injection moulding (MIM) process is fairly complicated and each process step is interactive. Furthermore, our μ -MIM technology normally deals with very complex designed small components in serial production. Thus, extra high-standard quality control is required both in and around the production line to satisfy the customers' requirements. This time, we will introduce our quality assurance.

MIM process and quality control

MIM processes can be categorised into five processes, namely 1) feedstock manufacturing, 2) injection moulding, 3) debinding and sintering, 4) additional post-processing and 5) measurement & inspection. In process 1), the material control in both metal powder and binder materials will be listed on top. In metal powder, incoming inspection, not only the chemical composition of the powder but also the powder size distribution and the shapes are measured. The storage control of the metal powder and the binder material is also important. If the storage condition is not appropriate, the degradation of the materials progresses faster and it leads to poor mechanical properties in the sintered components. The MIM feedstock kneading process, enough shear stress should be applied to the elevated temperature feedstock to gain a uniform distribution of metal powder in the feedstock. At the same time, careful temperature observation of the feedstock is required to avoid the thermal degradation of the binder, which will suppress the productivity significantly. Additionally, our μ -MIM components are mostly quite small and the volume of the component can be smaller than a pellet. Therefore, we take extra good care of the uniformity of each single pellet quality.

In 2), the injection moulding process, the highest stress is applied to the feedstock. Due to the high stress in elevated temperatures, unexpected binder degradation can be seen. Since we recycle the runner or miss shot green parts, the close observation of feedstock during the injection moulding is also held. The precise weight measurement is deployed for the quality evaluation of green parts in general. Also, the appearance inspection is conducted to improve the material yield.

The final component quality will be determined by 3) the debinding and sintering process, thus the quality control is also important but different type of controls are required. The debinding process can be held in 2 steps, 1st and 2nd debinding. With the 1st debinding, the majority of the binder is decomposed and in the 2nd debinding, a very little binder to support the metal powder particle in shape is remaining and that little amount of the binder will be decomposed in higher temperature than the 1st debinding. Generally, this 2nd debinding is held in the sintering furnace. There are many MIM manufacturers that operate the 1st and 2nd debinding in separated furnaces but we, μ -MIM, conduct all in one process. The 1-furnace operation requires good atmospheric control during the debinding process, compared to the separated furnace operation. Therefore, the furnace price will be much higher than the separated type. However, our system can avoid a loss by the handling in between the debinding and sintering process handling, since the post 1st debinded parts are very fragile. In the sintering process, more than 10% in linear shrinking by thermal diffusion among the metal powder is observed. So, it requires the appropriate selection of the ceramic plate selection, e.g., the material, porosity, design, operation condition, etc. for realising stable quality serial production.

In 4) secondary processes, the surface finishing (sandblasting, tumbling, plating), the machining (tapping, coining), the thermal treatment (ageing, precipitation hardening) can be listed.

As the last process, 5) delivery inspection includes the appearance visual inspection, tolerance inspection by micrometre, 3D optical measurement system, X-ray CT, and some chemical composition measurement by SEM-EDX, combustion test.

ISO13485 certified quality assurance

μ -MIM quality assurance system is certified by ISO 13485 since the demand from the medical devices manufacturing industry keeps increasing. As mentioned above, there are many control values and points according to the process step and that will be multiplied by the component's design. We keep improving our quality assurance system as the measurement technology develops.

Ref. Handbook of Metal Injection Molding Second Edition §13 Qualification of metal injection molding

Column



Hello, I am Sakai who works in the production department. I am taking responsibility for injection moulding and internal system management. I have been working for 7 years and I feel there has been a big development of information technology via my system control work. Also in injection moulding work, the injection machines are the same as before but the injection parts became more complex.

On weekends, I enjoy watching sports. I used to visit the competition on-site to cheer for my favourite team, but I watch those matches on TV at home, nowadays. Recently, I visited the Ise shrine and Atsuta shrine to pray for a return to normality in the near future. I also enjoyed the local dishes on the way back home from the shrines.