

## Treating and the modern mould make high speed

One, summarizes

1 the present situation that the mould makes at present and trend

The mould is important handicraft equipment , occupies decisive position in industrial departments such as consumer goods , electrical equipment electron , automobile , aircraft fabrication. The mould is important handicraft equipment , occupies decisive position in industrial departments such as consumer goods , electrical equipment electron , automobile , aircraft fabrication. Industrial product part rough process 75%, the finish machining 50% and plastic part 90% will be completed from the mould. The Chinese mould market demand already reaches scale of 500 hundred million yuan at present. The automobile mould , the annual growth rate covering piece of mould especially will exceed 20 %; Also prompt building material mould development , various heterotype material the mould , wall surface and floor mould become new mould growth point , plastic doors and windows and plastic drain-pipe increase to exceeding 30 by in the upcoming several years %; The home appliance mould annual growth rate will exceed 10 %; The IT industry year increases % speed equally exceeding 20 , the need to the mould accounts for 20 of mould marketplace %.2004 annual Chinese machine tools implements industry output value

will continue to increase. Our country mould fabrication market potential is enormous. The basis data counts , in recent years, our country mould year gross output value reaches 3 billion U. S. dollar , entrance exceeds 1 billion U. S. dollar, exceed 100 million U. S. dollar outlet. Increase by from 25% to increase to 2005 50% of 1995. The expert foretells that abroad: Asia portion being occupied by in mould fabrication in the whole world, will from 25% to increase to 2005 50% of 1995.

Chinese mould industry has been expanding by leaps and bounds , has formed east China and two big South China bases, and has expanded gradually arriving at other province. In 2002 (Shandong , Anhui , Sichuan) in 1996 ~, mould manufacturing industry output value annual average growth 14% , grows by 25% in 2003. In 2003 our country mould output value is 45 billion RMB. The gross product place occupies the world the 3rd, exports a mould increases 33.5% compared to last year 336,800,000 U. S. dollar. But, contents low our country technology moulds already pile up in excess of requirement , very most support of accurate , complicated top grade mould imports. Every year the entrance mould exceeds 1 billion U. S. dollar. Exceed 100 million U. S. dollar outlet.

Precise mould accuracy requires that 3 mu ms , large-scale moulds require that 8000 satisfied kN agree well with model force injection machine request in 2 ~; The minitype mould needs the request satisfying the diameter 1 mm silent stock tube. At present, adopt quick-cutting to produce a mould already becoming the general trend that the mould makes, a few moulds have produced a manufacturer in abroad , high-speed machine tool large area has substituted the electric spark machine tool , quick-cutting has improved the mould efficacy greatly. Machine tool enterprise aims at mould manufacturing enterprises , some treating centres 60% all above of the machine tool producing a factory sells treating enterprise to a mould. The mould fabrication enterprise substituting the electric spark finish machining mould gradually in abroad has adopt quick-cutting already commonly , quick-cutting has produced a mould already becoming the general trend that the mould makes gradually , has improved the mould efficacy and mass greatly. Adopt quick-cutting to replace electric spark producing a mould , can get on the stick obviously , improves mould accuracy , life time growing.

2 high speed processes application in making in the mould

2.1 quick-cutting merit:

1) cutter high rotation rate and the machine tool height enter be given to and high acceleration , improve metal excision rate greatly;

2) quick-cutting diminutions cut a force;

3) quick-cutting heat major part generate heat from the cuttings entrainment , workpiece being short;

4) quick-cutting cut down vibration , improve treating mass;

2.2 high speed treating apply to the beneficial result that the mould processes

1) fleetness rough process and half finish machining, improve treating efficiency;

2) high speed high-accuracy finish machining replace only entire the height processing , indicating mass , form accuracy rise , 50%, cuts down repair a mill by hand than EDM processes a potentiation;

3) cuts the surface processing final molding stiffly , improve surface mass , form accuracy, the treating (not only being that surface harshness is low, and the surface radiance is high) , being used for complicated surface has more advantage;

4) the surface loss that EDM treating produces , improve mould life-span 20%;

5) processes an electrode rapidly combining with the CAD/CAM technology , especially, the form is complicated , thin-wall is similar to an electrode.

3 adopt quick-cutting to process a mould needing the problem solving

In in the homeland, since the aspect cause such as fund , technology , the quick-cutting applying produce a mould be in the initial stage stage. Return the machine tool , cutter , handicraft back to existence as well as some problem of aspect needs to proceed orderly other solve.

The shortcoming is that finished cost is high, correct cutter sigmatism have comparatively high demand, can not have used big cutters , need to have the complicated computer programming technology to be used for support , equipment running cost height.

Two, the high speed processing a mould's processes a machine tool

Mould finish machining and hard cutting treating require that the numerical control high-speed machine tool , form board , model put up the precision processing need , high-effect numerical control machine tool etc.The mould aiming at produces a lot of machine tool enterprise , some treating centres 60% all above of the machine tool producing a factory sells enterprise to a mould.

The fixed assets having 5 billion yuan without exception in the upcoming several years throws into mould industry , 80% is the machine tool buying a mould process equipment , just saying every year having 4 billion yuan of RMB to buy Jinjie among them.

At present average our country numerical control machine tool utilization ratio approximately 20%, the high-speed machine tool utilization ratio 3 ~ 5%. Also, mould enterprise has the unit suitable to buy a high-speed machine tool , complies with 6000 ~ 40000 rmp's to have.

1 high-speed machine tool technology parameter demands

Process centre chief axis high-power , high rotation rate , satisfied rude finish machining; The finish machining mould wants to need to reach 15000 ~ 20000 rmp like the cutter , the machine tool with minor diameter. Generally, the chief axis rotation rate machine tool under 10000 rpm can carry out rough process and half finish machining , cannot reach the finish machining accuracy;

Have no way to reach 400 the above m/min cutting speed.

2 five scrolls of machine tools application increases a trend

- 1) treating route is nimble , the surface form is complicated;
- 2) treating range is big , the various type mould suitable processes;
- 3) cuts life-span of condition easy to cut down cutter wear , to raise a cutter,;
- 3 the softwares buying CAD/CAM and high-speed machine tools assort

On the grounds of the machine tool , major part counting , having several billions U. S. dollar to be used to enter port every year, the electromachining machine tool and the high-speed machine tool need to import.

Three, quick-cutting mould cutter technology

Quick-cutting processes the cutter needing allocating proper quick-cutting. Progressing processing cutter material's in high speed has urged development of high speed treating. The cutter , knife edge headquarter and high tenacity base gathering crystal strengthening the ceramics cutter being able to be used giving consideration to high hardness experience and observe carbide alloy coating becoming possibility. Gather the crystal cube nitriding boron (PCBN) bit, whose hardness may amount to 3500 ~ 4500 HV. Gather crystal miamond (PCD) it's hardness but amount to 6000 ~ 10000 HV. Germany SCS , Japan Mitsubishi (magical steel) and Sumitomo ,

Switzerland Shanteweike , USA Kenna are in recent years swiftly large wait for the famous abroad cutter company to successively have debuted the respective quick-cutting cutter, not only cutter having average structural steel of quick-cutting, the ceramics cutter still having direct quick-cutting of energy quenching hard steel is waiting for an effect to surpass the hard cutter, especially the coating cutter appears all of a sudden , bringing into play in quenching half finish machining and finish machining of hard steel. New cutter material and cutter technology appearing already make the bottleneck problem that high speed has processed no longer be able to appear on the cutter.

But, expensive entrance cutter price also blocks quick-cutting mould key factor.

Above to come to saying the cutter and the cutter holder acceleration reach 3 gs the sort, the cutter circular runout needs to be smaller than 0.015 mm, but the knife length is unable greater than 4 times cutters diameter. The reality according to SANDVIK company has counted , the carbide alloy has stood on in the entirety using carbon nitriding titanium (TiCN) coating when milling cutters (58 HRC) carry out high speed bright metal chopping , rough process cutter linear speed has been 100 m/min about , whose linear speed has exceeded but 280 m/min when finish machining and microstoning. Such demands to cutter material (include the hardness , tenacity , red hardness keep the form (include row of crumbs function , surface accuracy , dynamic balance sex etc. (cutting the function) , the cutter under high temperature state)) as well as cutter life-span all has very highly.

Experience according to in the homeland mould high speed finish machining, linear speed has exceeded 400 ~ 800 m/min when adopt the young diameter ball head milling cutter to carry out mould finish machining. The machine tool choosing sufficient high-speed's cuts mould finish machining stiffly.

Delcam adopt 0.8 mm diameter cutter to process the narrow slot , rotation rate 40000 rpm , 0.1 mm depth, feed speed 30 m/min.

1 chooses the cutter parameter , the cutter waits if shouldering an anterior angle. The cutter requires that the ability processing request shock resistance tenacity more highly , requiring that heat resistance pounds than average is strong;

2 adopts various method improving cutter life-span , reduces cutter cost.

3 adopt the high speed hilt , HSK hilt , heat pressing applying the most being at present to pretend to grip a cutter. Pay attention to a cutter pretend to grip overall in the day afer tomorrow dynamic balance;

4current cutter enterprise has already done many jobs in the field of the technology resolving the quick-cutting cutter , serving facing the cutter processing may help to solve much problem , the cutter has produced a manufacturer becoming the main body , the reference cutter has produced the technology parameter that the manufacturer provides.

Four, improve quick-cutting mould efficiency technology

1 cutter diameter and the length choice

2 HSM and the EDM choice

3 does cutting and the lubricating cooling

4 feeds choice: Move forward generally giving amounts <milling cutter diameters 10% , move forward giving a width <milling cutter diameter 40%. According to material, condition chooses the parameter processing handicraft rationally

High speed bright metal cuts the mass processing part material abroad fairly good, material quality level is identical , the treating function comparison is stable; But, the cutter that the company produces abroad is also that the standard makes an experiment with their material; The treating being recommended by is suitable to their standard comparatively like the parameter , material quality has the certain difference with domestic part , this difference shows comparatively obviously , some parameters can apply directly, but some effect dispatches right away comparatively during the period of high speed bright metal chops if using their cutter. But select and use part material quality in the homeland like enterprise having the certain standard, what be put into use part material, can use the part material quality that high speed processes especially , the general meeting is limited in some part material range inner, that this applies the high speed processing technology to us has also provided advantageous condition , has been able to apply to less treating material within range. Being needing to emphasize that here, must choose the treating technological parameter optimizing out a set of capital suitable enterprise on these material , is brought into company standard and.

The technology selecting and using the domestic cutter , seldom having the bright metal recommending high speed to chop parametric , is necessary making an experiment, get the comparatively satisfied parameter , produce a manufacturer had better to select and use the fixed cutter , cut down the number of times testing that , the standard forming a processing technology, such can improve effective utilization ratio of equipment , lowers production costs , can get the fairly good economic effect.

Five, quick-cutting route processing a cutter and programming

1) flat surface feeds the route choice

2) 2) outlines process the route choice

3) Keep cutting loading stable

4) keeps relatively stable moving forward giving amounts and feed speed

5) keeps the garden corner in flat surface cutting

6) chooses the finish machining margin rationally

Programming demand of HSC finish machining to CAM:

1) the bright metal avoiding a corner to the full cuts motion;

2) tries one's best to avoid external feed of workpiece and enter next depth return knife motion , direct from the outline. Or adopt a helical line or being sure enter slanting to moving forward;

3) constant each edge feed , improve the quality, prolongs cutter life-span;

4) outline treating are kept waiting in level surface.

Quick-cutting CAM software:

Several years ago will have started quick-cutting processing programming technology research, the Delcam company , has developed the quick-cutting automation programming software module; Lately, the MasterCAM company has also developed the quick-cutting automation programming software module; You also are in in the homeland north navigation developing the quick-cutting automation programming software module;

Six, high-speed machine tool numerical control system characteristic

1) high speed data is processed

2) corner forecasts are handled

3) NURBS are not justified appearance strip runin curve treating

Seven, safe quick-cutting mould problem

1) Monitoring wearing a cutter away and destroying;

2) Intensity that the bit links;

3) Strict with the machine tool and the cutter examination is very important and before the average machine tool processing diversity , safety protects and starts up.

Eight, there exists problem in our country at present in adopt high speed to process the mould technology

1 machine tool:

1) domestic high-speed machine tool overall function still has the gap , the function component function to be able to not satisfy a request. Power and rotation rate including the electricity chief axis, entrance machine tool price is high;

2) Under the machine tool high speed, the dynamic behaviour studies the function being not enough to affect a complete machine as a result,;

3) The five scroll of machine tool is not enough mature , entrance machine tool price is very high;

4) supporting technology and equipment are fairly incomplete

2 cutters:

1) domestic cutter is not able to adapt to the quick-cutting application , high speed cuts only entire treating especially stiffly. Entrance cutter price is high. The cutter technology is to affect quick-cutting processing a key factor of mould.

2) supporting technologies are not enough to include hilt , online dynamic balance in complete set etc..

3 high speed moulds process the technology and the experiment

1) Be short of the accumulation applying experience since high speed processes the mould history comparatively shortly,;

2) The comparison studying comparison stops throwing into lack, sets up a project to quick-cutting handicraft is difficult;

3) Be short of the quick-cutting data base or the handbook , is still blank space at present;

4) moulds produce the manufacturer cognition lack to quick-cutting , the analysis contrast

being short of long range beneficial result;

4 Be short of the quick-cutting automation programming software;

5 Be short of a five scroll of gear quick-cutting automation programming CAM software.

#### Concluding remark

The mould marketplace has the intense need, but technology to be unable to keep abreast with to high speed treating. Starting is late , the basis is relatively poor , overall engineering level not being taller than , develops slowlyRequire that one by one, aspect coordinated growth , the product mimic inkstone throwing into combining with enlarging, each comprehensive utilization aspect strengths drive quick-cutting application in making in the mould.. Our hope , effort passing every aspect, before the market demand push go down , pass technological progress, look like automobile , machine tool , home appliance , before long, not only our country being going to become a mould producing Great Power, and be going to become a mould producing the powerful country.

#### References

- 1, Jin Diecheng , Song Fangzhi. The modern mould makes the technology , Beijing: Mechanical industry press, 2001.
- 2, Xu Hefeng, The digitization mould makes the technology , Beijing: Chemical industry press, 2001.
- 3,Zhao Bo ,High speed processes the forward position technology that the mould processes. Mould technology , 2000 , (2)
- 4,Zhang Haiou,The fleetness mould makes the technology current situation and their developing trend. Mould technology , 2000 , (6)
- 5,Guo Dongming,Wang Xiaoming,Be geared to the needs of the particular kind processing technology that the fleetness creates. Chinese mechanical engineering , 2000 , (11)