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Chemical Blanking and Chemical Milling Process an Outline

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ABSTRACT: Non-traditional machining processes are widely used to manufacture geometrically complex and precision parts for aerospace, electronics and automotive industries There are different geometrically designed parts, such as deep internal cavities, miniaturized microelectronics and fine quality components may only be produced by non-traditional machining processes. This article discusses the principal process steps, specifications, defects, applications, of chemical blanking and chemical milling process in manufacturing industry. The process steps include precleaning, masking, scribing, etching, final cleaning, stripping, and mechanical finishing. The article describes the variables that affect undercut and surface finish obtained by CM. The mechanical properties of chemically milled parts are also discussed. Paper describes the chemical machining process, industrial application, applied chemical etchants and machined materials.

Keyword: Non-traditional machining, Chemical machining, Chemical blanking and Chemical milling process.

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I. INTRODUCTION:

Improved chemical milling process and chemical blanking process resulting product utilizing photographically exposed and developed resist designs on a metal plate with unexposed portions of the resist emulsion dissolved away, characterized by a baking step or steps harder than conventional, a series of controlled etching treatment on one side,and a series of differently controlled harsher etching treatment on the other side, resulting in a design of suspended metal areas having substantially flat plane or slightly concave etched edges as distinguished from shoulders or ridges. A particular application is for producing electrical circuitry utilizing a metallic plate containing identical circuit designs on both sides formed of the photographic etch resist, and upon removal of the unwanted metal by the differential etching steps on opposite sides of the plate, obtaining an integrated circuit structure with conductors responding to the etch resistant pattern and in cross section being substantially rectangular with parallel top and bottom and parallel sides, or with the sides very slightly concaved, thus providing adequate surfaces on the sides for attachment of wires by welding. There are two types of chemical machining process. Chemical blanking, which is used for cutting or stamping parts from thin sheet materials, Chemical contour machining or chemical milling used for selective or overall stamping part from a thick workpiece material. A brief description and characteristics of chemical blanking and chemical milling process are discussed as follows.

Chemical Blanking Process:

Chemical blanking is a process of producing a part from thin sheet metal by chemically etching the periphery of the desired shape. The material is removed by chemical dissolution. Chemical blanking is used for parts that are otherwise typically produced by mechanical blanking presses from thin plates and foil material. With mechanical presses, vibrations, backlash, and part distortion will make smaller parts difficult to produce.

Steps of chemical blanking: Chemical blanking process has several steps for producing machine parts. These are given below:

1.Workpiece pre cleaning process: The surface of the workpiece metal is cleaned thoroughly, degreased and pickled by acid and alkalis. Pre cleaning is of utmost importance in order to remove oil, grease, dirt, rust or any foreign substance for

the work surface so as to produce a good adhesion of the masking material. The material is allowed to dry.

2.Masking: Masking involves covering the portions of the workpiece metal where material is not to be removed by the chemical action of the etchant. Refer figure 3(a). A suitable maskant, say a polymer, rubber, or any other material is selected based on the workpiece material. The maskant is applied on the work surface by various methods like dip, brush, spray, roller, electro-coating, and as well as adhesive tapes.

3.Etching: Removal of material from the workpiece take place by etching process. The workpiece metal is either sprayed continuously with a selected etchant like ferric chloride on those portions where the material is to removed, or immersed in a tank of agitated etchant, where the etchant chemically attack those portions not masked. Erosion of the work material take place both inward and laterally from the exposed(unmasked) surface as shown in figure3(b) to (d). The work material is converted in to metallic salt, which is the dissolved and carried away in the etchant solution. There are two application of material through etching. Immersion type and Spray type. With the immersion type, the part is immersed in the corrosive liquid, and the liquid is constantly stirred. Air injection is the widely used stirring method.

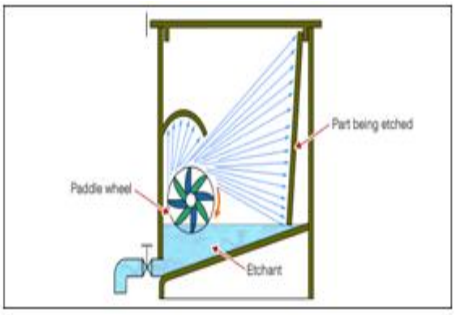

Figure .1 Immersion type

The spray method of etching employs specially designed etching machines. Spray type machine has nozzle(s) that spray the etchant, and Paddle type has a rotating wheel with paddles that spray the etchant. Both types are made in vertical and horizontal configurations, as well as single sided etching and dual side etching types.

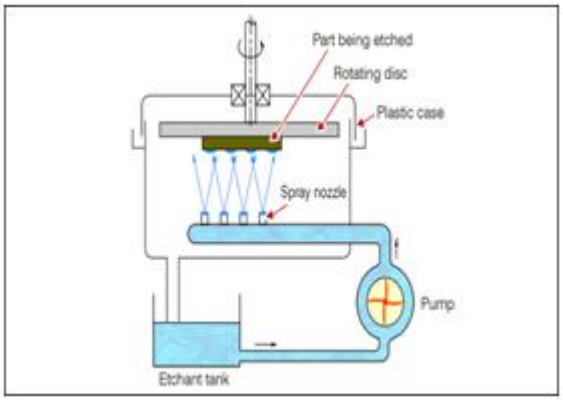

Fig.2 Spray type

4.Demasking: When etching is completed, the mask is removed either through mechanical or chemical means Any etchant on the material is also removed with a wash or clear, cold water. A deoxidizing bath may also be required in order to remove the oxide films left on the surface of the work material.

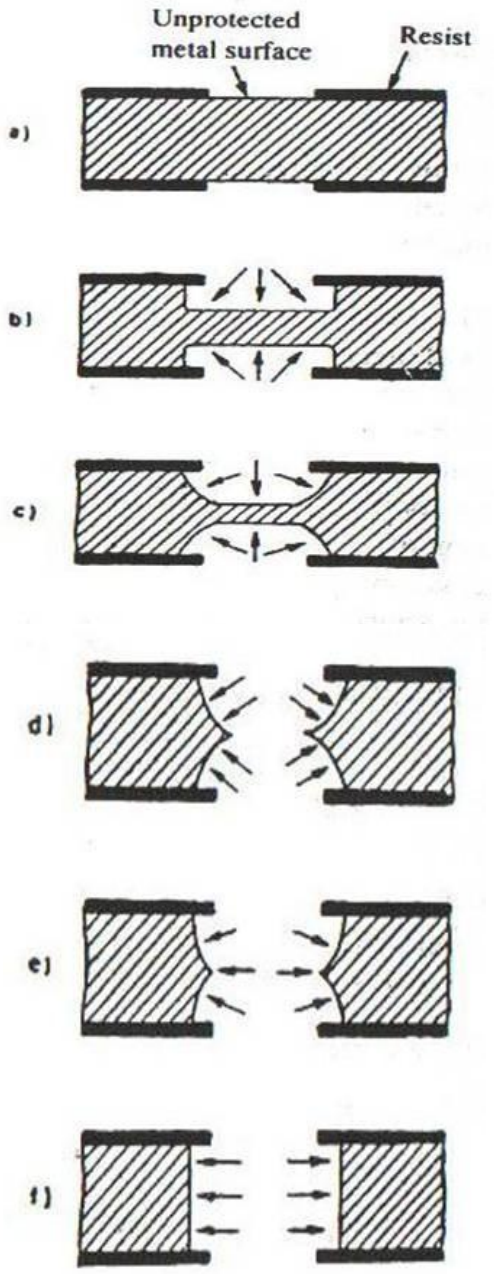

Figure 3 Chemical Blanking process

Chemical Milling or Contour Machining Process:

Chemical milling is a process used to produce shapes by chemical etching selective portion of material from the relatively large surface area of work metal. The main purpose is to produce shallow cavity with complex profiles on plates, sheets forging, generally for the overall reduction of weight. Chemical milling as shown

Steps of Chemical Milling: Chemical machining process has several steps for producing machine parts. These are given below

1.Workpiece pre cleaning process: The workpiece material has to be cleaned in the beginning of chemical machining process. The cleaning operation is carried out to remove the oil, grease, dust, rust or any substance from the surface of material. A good cleaning process produces a good adhesion of the masking material. There are two cleaning methods; mechanical and chemical methods. The most widely used cleaning process is chemical method due to less damages occurred comparing to mechanical one. Ultrasonic cleaning machine is applied with using special cleaning solution and heating is beneficial during the cleaning process.

2.Masking and Scribing mask: Masking involves covering the portions of the workpiece metal where material is not to be removed by the chemical action of the etchant. The selected masking material should be readily strippable mask, which is chemically impregnable and adherent enough to stand chemical abrasion during etching. Scribing mask is guided by templates to expose the areas that receive chemical machining process. The selection of mask depends on the size of the workpiece material, the number of parts to be produced, and the desired detail geometry. Silk-screen masks are preferred for shallow cuts requiring close dimensional tolerances.

3.Etching: This step is the most important stage to produce the required component from the sheet material. This stage is carried out by immerse type etching machine. The workpiece material is immersed into selected etchant and the uncovered areas were machined. This process is generally carried out in elevated temperatures which are depended on the etched material. Then the etched workpiece is rinsed to clean etchant from machined surface.

4. Cleaning masking material: Final step is to remove masking material from etched part. The inspections of the dimensions and surface quality are completed before packaging the finished part.

Application: It is mostly used in aircraft industry. This process is best suited for production of printed circuits , where the basic connections of the circuit consist of thin metal strips attached to a insulating board faced with a thin layer of copper .Besides, it remove metal from a portion of entire surface of formed or irregularly shaped parts such as forging casting, extrusions or formed wrought stock. The surface finish obtained in this process is in the range of 0.5 to 2 microns. One of the major applications of chemical milling and blanking is in the manufacture.

Environmental issues: Environmental issues in chemical machining operations may be the most important factor affects the machining process should be used or not. Most of the chemicals such as cleaning solutions, etchants, strippers etc. are very hazardous liquids. Therefore handling and disposal of them are very costly. Industrial trend of using these chemicals are to select more environmentally accepted ones for chemical machining process. Moreover, regeneration of waste etchant and etched metal recovery from waste etchants have been studied and there could be a suitable regeneration/recovery system for some etchants like FeCl3, CuCl2 and alkaline etchants.

II. CONCLUSION:

In the past, chemical milling operations have not had a good reputation regarding environmental issues. Maskant application emitted large volumes of solvent directly to the atmosphere, etchant tanks required frequent dumping due to saturation of sodium aluminate, sodium hydroxide was not recycled and large volumes of water were polluted and discarded.

Today, several new technologies have emerged regarding chemical milling maskants. Solvent collection has been developed and enables recovery rates in excess of 95% and is available for recycle. Sodium hydroxide and aluminium can also be recycled which enables improved process efficiency and reduced costs. There is always room for further improvement, but considerable progress has been achieved.

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