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Application of sand dunes in the machining of molds of composite materials

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Abstract **— The composite materials are largely used (aeronautical, railway, automobile, etc….) because of their advantageous mechanical properties (weight ratio/resistance). Because of the complexity of the phenomena present in the zone of cut, current knowledge on their machining is limited and prevents their optimal use. Of share their constitution, these materials pose many problems during their machining. The objective of this study is to ultra seek the parameters of cut during the composite machining of materials Concrete High efficiency (HPC) and Concrete Fiber Ultra High efficiency (HPCF) is proposed for the manufacturing of the moulds to carry out parts out of composite materials, or the materials used for the manufacturing of the moulds of the composite material parts like polyester, silicone and resin epoxy etc. , do not resist high temperatures, and also to analyze the behavior of the composite concrete during machining. Allowing to avoid the appearance of the defects (heating and wear of the cutting tool). An experimental design of machining of some tests was defined for the research of the parameters of cut (cutting speed *Vc*, depth of cut *ap* and advances by turn *f*). The variation of the parameters of cut for each test showed that machining after treatment to cause problems in particular on the level as of cutting tools and the appearance of the quoted defects.**

Keywords: machining, HPC, HPCF, mould, composite materials, parameters of cuts, surface quality.

I. INTRODUCTION

The current challenge of the industrialists is based more and more on the profit of time and the reduction in the manufacturing costs while respecting the environment. Among these industries, machining occupies a very important place in the technical family of manufacturing of machine elements. The principle of machining is to remove matter so as to give to the blank the wanted form, using a machine tool. By this technique, parts of a high degree of accuracy are obtained. During the machining of a part, the removal of matter is carried out by the conjugation of two relative movements between the part and the tool: the movement of cut (cutting speed) and the movement in advance (speed in advance). There exist two manners of generating required surface: by work of form or work of envelope. In the case of the work of form, it is the shape of the sharp edge of the tool which conditions surface obtained. In the case of the work of envelope, it is the conjunction of the movements of cut and in advance which defines final surface. Nowadays, machine tools of digital control, i.e. brought under control by a computer system, make it possible to automate partially or completely the procedure. At the time of the cut, the matter in interference with the trajectory of the tool is detached by plastic deformation moreover of the part and is transformed into chips. The characteristics of surface depend on the couple tool-matter, i.e. parameters concerned during the cut (cutting speed, speed in advance, depth of cut,…). In machining, there exist several configurations usable according to the process of cut (turning, milling, drilling,…). In the context of our study, we will be interested more precisely in the first two techniques the most used namely:

– Plane correction, application on a concrete HPC part;

– Milling, application on a material concrete HPC and HPCF. This work in two parts was shared:

II. OPERATION OF SURFACING WITH A STRAWBERRY

Part A: Machining of the new Concrete with cutting tool mills out of metal carbide The machining of Concrete HPC where HPCF with for goal to manufacture a mould for composite material part, or to give simple form or to complicate, or to correct the surface quality during use of the Concrete mould several times. To be done from there, it is necessary to know the parameters of cuts of the Concrete. The preliminary test of the machining of the Concrete and surfacing as shown in the figure

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Tool mills two metal carbide Sizes

Figure 1: surfacing with tool out of metal carbide

*According to the formula N= 1000Vc/π*D one finds a value of 630tr/min and*

Vf =770mm/min, as of the first master key appears a flame in a zone of the part as indicates it the following figure:

Figure 2: problem of machining

What it will explain for this zone; that is to say the material is very hard that the tool or the parameters of cuts is male selected.

The parameters of cut one will know:

To keep the speed of the pin.

Vary speed in advance.

Or conversely.

One notes:

For a speed of 112tr/min and speed in advance of 215mm/min; it is noticed that this material is very hard and this kind of work of surfacing with a tool mills two metal carbide Sizes is not appropriate; because the tool with heated and has to change its state and even carries it tool to roasted; during machining one notes that the tool crushes material it does not have their cut. In short: Even however the cutting speed and speed decreases by it in advance; this nuance of the matter of tool is not appropriate for the machining of concrete HPC where HPCF. With another test one takes the same tool with a speed of 40 tr/min the mini value on the machine, and even speed in advance one notes that stop them cutting changed color as of the first master key and the same stop them cutting are to damage, so takes some of other passes one notices that the tool will damage all stop them cuts because the material Concrete with machined east constitutes of sand of dune which contains silica grain which explains the hardness of this concrete and the black zone in figure 3.

Figure 3: problem of machining and variation of the parameters of cuts

For the test of following surfacing one used a strawberry two Sizes diameter 80mm to brought back plate SANDVIK with a rotational frequency 630tr/min and advance a value of 125mm/min; during machining in the first does not pass from remark; for the second master key at the end of the operation of surfacing it appears a flame, this flame and due to the temperature due to friction tool part, one stopped the machine for bomb disposal expert the rotational frequency of 630tr/min to the value 315tr/min it there is always problem of machining, there thus one has to decrease speed until 160tr/min and the flame is disappeared.

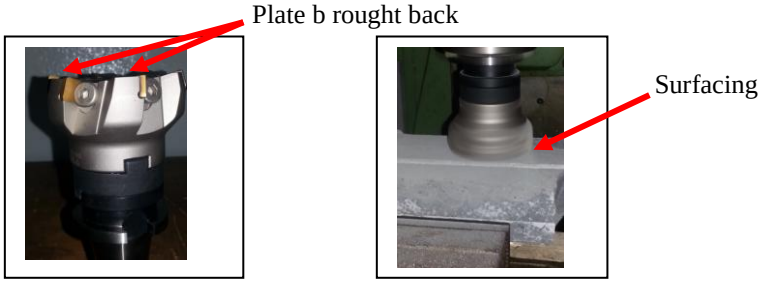

Figure 4: strawberry 2 T with plate brought back nine.

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For a test of surfacing on another concrete HPCF part one raised two points essential 1st it is that if one takes the same cutting speed with a depth of cut equal or lower than 1mm, one notes that it there is no problem of machining but for the 2nd point if the depth of cut is increased one notices the appearance of a flame there one intervened for decree the machine, to decrease the number of revolutions until 160tr/min, the following figures explains the phenomenon.

Figure 5: Before reducing speed.

Figure 9: After the reduction speed.

The operation of surfacing on a Concrete part HPCF (Concrete fibre ultra high efficiency) with milling showed that machining without use of lubrication was one can difficult because the part is very hard, to maintain the form of stop cuts it is necessary to use lubrication; after use of the last one has vary the number of revolutions of 630tr/min until the speed of 160tr/min for the 1st speed one notices the light-back even with the use of lubrication as indicates the figure so below but the 2nd disappearance of the flame; thus even with the use of lubrication one notices the appearance of the flame. One can calculate the advance F of the formula:

$$vf = N * f \qquad d'ou: f = \frac{vf}{N} = \frac{125}{160} = 0.78125mm$$

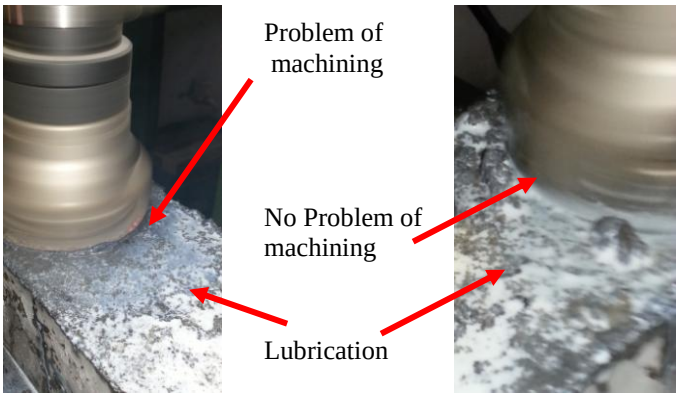

Figure 6: appearance of a flame has speed 630 and 315tr/min

Figure 7: disappearance of the flame until speed 160tr/min.

III. COMPLETION WITH CUTTING TOOL

The finishing operation with a cutting tool then remains the last operation for obtaining a quite polished surface quality; for that one makes a control of surface quality by one installs roughness.

The measurement of roughness with installs roughness shows that the machining of Concrete (HPC and HPCF) without or with lubrication does not give a good performance for was of surface according to the measurement of several points in the two parts. For the other Concrete part (HPCF) Concrete fiber ultra high efficiency after surfacing with lubrication one recorded for three points of surface roughness as shown in the figure herewith a reduction of the value of roughness what wants to say that tends some towards a good performance of surface quality.

Graph of roughness Ra (µm) according to number of revolutions (tr/min) :

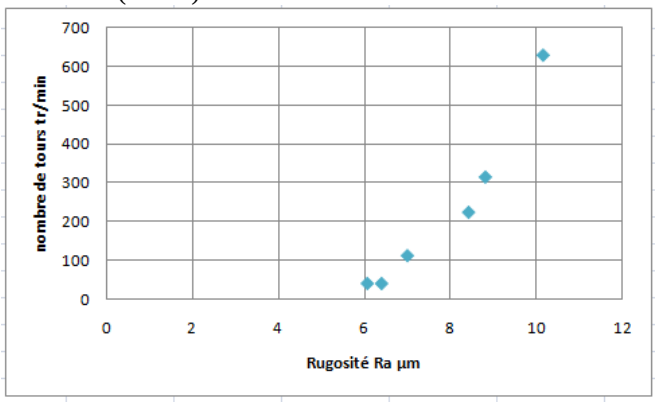

Figure 8: Graph of roughness Ra (µm) according to number of revolutions (tr/min)

one notices that the surface quality to be increased it becomes more polished by decreasing the number of revolutions, but remains insufficient in front of roughness by measuring the last 6.08µm. The following tables illustrate the tests of two materials HPC and HPCF.

IV. CONCLUSION

In this work we have to treat a general information on the machining of composite materials concrete and given the parameters of cuts for each kind of machining (milling, plane correction, drilling….), the defect of machining of composite materials; but for the composite kind of material Concrete HPC where HPCF it should be machined has the fresh state without treatment to form the model of the mould i.e. in the 1st day of the release from the mould, then to make a heat treatment after machining can about it use it to increase the characteristics of material to mould the composite material parts. The operation of surfacing of a mould out of Concrete (HPC) or (HPCF) treaty with the drying oven because several problems in particular on the level of the cutting tool out of metal carbide even by using lubrication; for a strawberry with plate brought back SANDWIK, one has manages to determine the parameters of cuts of material HPC and HPCF. The results obtained helps us to fix these parameters for the machining of this material, a number of revolutions of 160tr/min and a speed in advance of 125mm/min and a depth of cut de1mm are sufficient for the machining of these materials. For obtaining a roughness of value of 6.08µm one

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takes a number of revolutions 40tr/min and speed in advance 240mm/min. The machining of the mould out of Concrete (HPC) or (HPCF) after thermal treatment the drying oven to cause problems of machining. Machining before treatment does not cause any problem with the same cutting conditions.

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