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CONSTRUCTION AND PERFORMANCE TEST OF WATER COOLING CPU

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Abstract*-In recent years, existing solutions for cooling personal computer CPUs have been supplemented by a new product category, factory sealed water cooling loops. These systems, consisting of a water block a fan, perform well compared to the air cooling solutions but are less effective than larger, custom-built water cooling systems. This project aims to explore the most important aspects of a factory sealed system and to identify possible cost-effective enhancements of the performance. The most significant differences between the different groups of water cooling loops is the block design .The performance of both categories is also largely dependent on the fan power, but increasing fan power has a large negative impact on the noise level. Water blocks can be designed in several different ways, both regarding the heat sink design and the flow direction. In practical, the water block is to be made of proper size that it can carry the heat from the processor of the computer by flowing water through it. Creating a competitive product in this product segment certainly seems possible, as there are performance-increasing changes to be made that seemingly has little impact on the production cost.*
Keywords: heat sink, water block, water cooling, heat exchanger.

1. Introduction:

Today, the most common method for thermal management of computer chips is air cooling, where the heat gets transported from the chip to a directly adjacent metal block from where the heat is transferred to the surrounding air. The metal block is generally made of aluminum that has a numerous extended surface fins around it. In water cooling the metal block is replaced by the water block that extracts the heat from the processor and the water flowing through it can carry the heat.
The main advantages of water cooling compared to conventional air cooling is that water can carry more heat than air. As being the most efficient coolant in various application water is used in this perspective.
Traditionally water cooling has only been used by a small group of computer users with considerable technical knowledge and interest. Now however factory sealed water cooling products are getting introduced to the market which eliminates much of the hassle and the risk of traditional solutions. These products give the user roughly the same performance as the top-of-the-line air coolers at roughly the same price point rather than being fully comparable to the more expensive and more powerful user-built water cooling systems.

A water-cooling system, on the other hand employs a series of coolant-filled tubes, a radiator, water blocks (the equivalent of heat sinks) and a couple of other components to keep PC feeling refreshed and cooler than simple air cooling.

Computer water cooling is a method used to lower the temperatures of computer processors and sometimes other components such as graphics cards using water rather than air as the cooling medium. Processor speeds have increased dramatically in recent years. As a result the heat given off by processors has also increased as has the noise associated with equipment such as fans used to keep them running at a safe temperature. Because water can conduct heat about 3 times faster than air. Water cooling system allows the processor to run at higher speeds while drastically reducing system noise. Some industry experts predict that water cooling systems will become standard for personal computers in the near future. Water cooling is increasingly used to deal with the special requirements of the data center. Because data centers are often assigned the most convenient available space rather than a space that is specially designed servers may be contained in too small an area or one that cannot be adequately ventilated. Further some data center technologies such as blade servers (which are densely structured) put increased stress on the data center's cooling system.

Water cooling brings its own issues to the data center however as well as benefits. Additional plumbing is often required. Water cooling can limit the flexibility of data center design because systems connected to

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plumbing cannot be easily rearranged. The combination of electronic systems and water also complicates disaster recovery planning (DRP) For example administrators need to know in advance how they will deal with potential problems such as rust or leakage. A common fear of combining electrical systems and water is another road block to acceptance of water cooling.

2. HEAT EXCHANGING PROCESS

In general process heat is transferred from higher temperature to lower temperature. In CPU the processor is in higher temperature than the atmospheric temperature. So heat can be exchanged between the processor and environment where heat is transferred to the environment. In this project this is emphasized that heat is transferred by applying force using the fan. When the water block is placed above the processor heat from the outside surface of the processor is being carried away by the fluid. Water flows continuously through the pipe to the water block so that it can carry the heat and get exhaust. Thus the temperature will decrease in the processor.

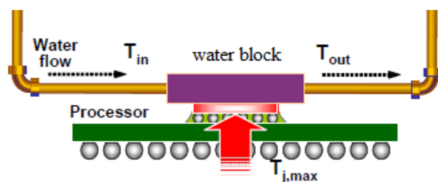

Fig 1: Heat exchange between the water block and the processor

3. CONSTRUCTION

In simple air cooling computer processing unit there has been a fan and a metal block of aluminum is set up above the processor. When the computer is on heat is generated in the processor. The aluminum fins extracts the heat from it. The fan starts to rotate at a very high speed from the very beginning of starting on the computer. The fan produces air flow that takes away the heat from the fins. Thus the fin is able to carry more heat from the processor unit.

But in case of water cooling CPU there should be a water block will replace the aluminum fins. For construction of the water block material should be chosen with high thermal conductivity so that the block can extract the heat from the outside of the processor. The dimension of water block is 1.5×1.5×.5 inch.

For connecting the water block with the inlet reservoir a proper piping system is required. Because while running this system if there is a leakage on the piping can cause the whole system to be failure. So for precaution copper tube can be used as the piping system instead of conventional plastic piping system. The diameter of the copper pipe was 6mm.

The fan that has been already is in CPU can be used for this purpose. So there are no such special requirements for additional fan system.

Fig 2: water block made of mild steel

Fig 3: CPU cooling fan

4. OPERATION

During the running of the computer water is forced to flow through the water block. It can be done by using a pump. But in case of using a pump the water will flow in continuous cycle. If water carries the heat the temperature of the water will go up and it will be hard to transfer the heat further more with the same water. To reduce the temperature a radiator will be needed. That will cost high and that is not desirable. So the water should not be flowed in the closed cycle. Water is flowed in this system by using siphon flow that will require proper height to flow simultaneously.

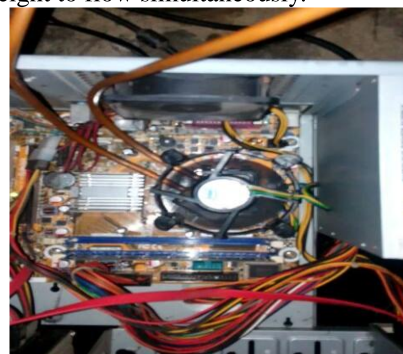

Fig 4: water block in operation below the cooling fan

5. RESULT ANALYSIS

After operation of water cooling the temperature of the CPU core has been measured by a software. For this purpose "Open Hardware Monitor" software has been

used. Readings of both load and no load conditions as been measured. It has been found that temperature has been decreased about 10-12◦c on both condition at every core of the processor.

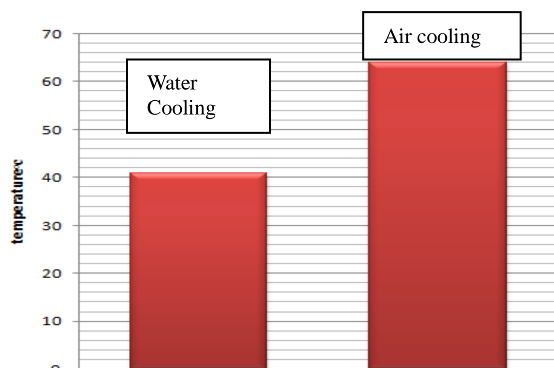

Fig 5: CPU core #1 at load condition

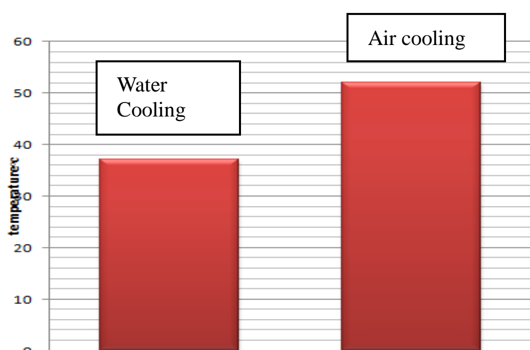

Fig 6: CPU core #1 at load condition

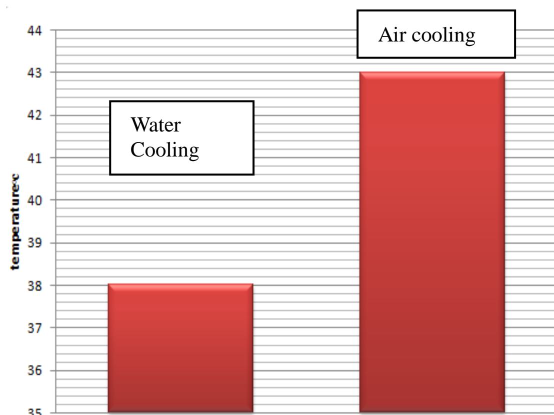

Fig 7: CPU core #2 at no load condition

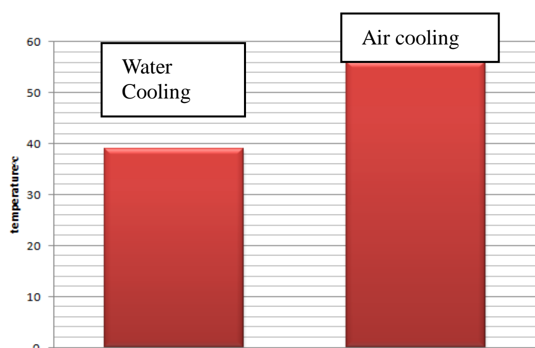

Fig 8: CPU core #2 at on load condition

6. CONCLUSION

As the power dissipation in high performance personal computers continues to increase, liquid cooling systems offer an excellent means to provide efficient reliable cooling with high cooling capacity and low noise. The design of all the key components of a liquid cooling system for PC's has been described. The wetted components of the cooling system were made from steel and copper which provide very good reliability with aqueous coolants in single-phase liquid cooling systems. A water block made of mild steel has been implemented in this project that can carry the heat. For piping system, copper has been used for the construction because it has the most thermal conductivity.

After running the computer both core temperature has been measured by reliable software. Temperature has been monitored for both at load and no load condition. It has been found that there has been a change in temperature between conventional air cooling and water cooling. All the required data has been taken for the analysis of performance of this project. As the temperature decreases to a satisfactory value it concludes that the objective of this project has been fulfilled.

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