

COOLANT MIXTURE SYSTEM AND METHOD THEREFOR

Field of the Invention

[0001] The present invention relates to coolant mixture system. In particular, the present invention relates to a system and method for mixing coolant for use by the industrial CNC machines.

Background

[0002] Coolant plays an indispensable role in the functioning of Computer Numerical Control (CNC) machines. It serves multiple purposes, the most crucial of which is to dissipate the heat generated during the machining process. This heat, if not managed, can lead to overheating of both the machine and the workpiece. Overheating not only compromises the quality of the workpiece but also shortens the lifespan of the machine's components. Therefore, the coolant acts as a safeguard, ensuring that the machine operates within optimal temperature ranges, thereby guaranteeing the longevity of the machine and the quality of the finished product.

[0003] Coolant require refreshments regularly. The coolant used in CNC machines is typically supplied in a concentrated form. This concentrated form is not directly usable and must be diluted before it can be loaded into the machine's coolant system. Ordinary tap water is generally sufficient, making the process more accessible and less cumbersome for operators.

[0004] However, the process is not without its challenges. One significant issue is that the coolant is usually oil-based. Oil and water are immiscible, meaning they do not mix well naturally. This characteristic poses a problem for pre-mixing and storing the coolant in a mixed form, as the oil and water components will eventually separate if left standing for an extended period.

[0005] Given the immiscibility issue, the mixing of coolant is often performed manually, and usually, it is done as and when needed. This on-the-spot preparation, while solving the problem of component separation, introduces its own set of challenges. The first is the issue of inconsistent mixture ratios. Manually mixing the coolant and water can result in a mixture that is either too concentrated or too diluted. Both scenarios are problematic: a too-concentrated mixture may not provide effective cooling, while a too-diluted mixture may compromise the machine's performance and the quality of the workpiece.

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[0006] Another challenge is the labour intensity of the manual mixing process. Preparing the coolant mixture requires dedicated labour, which is not only a drain on manpower resources but also introduces the possibility of human error. This labour could be better utilized in tasks that cannot be automated, thereby improving overall operational efficiency. Furthermore, the manual preparation process is time-consuming. Time is a critical resource in any manufacturing or machining operation, and any delay, even if minor, can have a cascading effect on the entire production schedule.

[0007] US patent publication no. US2018/0272489A1, entitled “Adjustable automatic dispensing apparatus” designed for controlling the dispensing of fluids,

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including coolants. While the apparatus aims to automate the fluid dispensing process, it is not without potential drawbacks. For instance, the apparatus involves multiple components like flow sensors, solenoid valves, and a programmable control unit. The complexity of these components could make the system prone to mechanical or software failures. Additionally, the initial setup cost could be high due to the multiple components involved, making it less accessible for smaller operations. Regular maintenance would also be required to ensure that the flow sensors and solenoid valves are functioning correctly, adding to the operational overhead. Furthermore, the apparatus is dependent on a power source for its operation, making it vulnerable to power failures.

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[0008] Incorporating these considerations, it becomes evident that while automated solutions like the one described in patent US20180272489A1 offer promising advancements in fluid management, they also come with their own set of challenges that need to be addressed. Therefore, there is still room for innovation in developing an apparatus that not only automates the coolant mixing process but also mitigates the aforementioned issues. This would further streamline CNC machining operations, making them more efficient and reliable.

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[0009] In summary, while coolant is essential for the optimal functioning of CNC machines, the current methods of preparing and using it are fraught with challenges. These range from the basic issue of immiscibility of its components to the more complex problems of labor intensity and time consumption in its preparation. These challenges collectively point to a clear and present need for an automated apparatus capable of handling the coolant mixing process efficiently and reliably. Such an apparatus would

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not only ensure consistent mixture ratios but also free up labor and save time, thereby enhancing the overall efficiency and effectiveness of CNC machining operations.

Summary

5 **[0010]** The present invention, in one aspect, seeks a coolant mixture system for preparing a coolant mixture for use in industrial CNC machine. The coolant system comprises a controller configured to regulate operations of the coolant system; a controllable valve connected to the controller electrically, the controllable valve further in fluid communication with a water source, wherein the controller operationally adjusts
10 the flow of water from the water source based on signals from the controller; a mixture pump having one inlet fluidly connected to the controllable valve for receiving water operationally, and the other inlet fluidly connected to a coolant source for receiving both water and coolant to be mixed therein, wherein the mixture pump has an outlet to discharge mixture fluid into a mixture tank; and an agitator electrically connected to the
15 controller, wherein the agitator is adapted to dispose within in the mixture tank while maintaining communications with the controller, wherein the wave generator is configured to agitate the mixture.

[0011] In one embodiment, the mixture pump is a Venturi pump, the Venturi
20 pump is configured to draw coolant into the mixture tank using a pressure differential created by the water flow.

[0012] In another embodiment, the agitator is a wave generator.

25 **[0013]** In a further embodiment, the agitator is activated in a periodic manner.

[0014] In yet a further embodiment, the coolant mixture system may further comprise a plurality of sensors. The controller may further configured to receive input from the sensors and to adjust the operation of the controllable valve, the wave generator, and the mixture pump based on the input from the sensors to maintain a predetermined
5 ratio of coolant to water in the coolant mixture.

[0015] The coolant mixture system according to claim 1, wherein the controller is a smart controller and further communicable with computer network, wherein the coolant mixture system can be monitored and controlled remotely through handheld
10 communication devices.

[0016] In another aspect, there is provided a coolant mixture tank that comprises the aforesaid coolant mixture system for drawing a concentrated coolant and at least one diluting liquid into said tank.

15 **[0017]** In one embodiment, the coolant mixture tank may further comprises a pump for dispensing coolant mixture from the coolant mixture tank into a transporting tank.

Brief Description of the Drawings

[0018] This invention will be described by way of non-limiting embodiments of
5 the present invention, with reference to the accompanying drawings, in which:

[0019] FIG. 1 illustrates an overall setup of a coolant mixture system in
accordance with an embodiment of the present invention; and

10 **[0020]** FIG. 2 illustrates a block diagram of a coolant mixture system in
accordance with an alternative embodiment of the present invention.

Detailed Description

[0021] In line with the above summary, the following description of a number of specific and alternative embodiments are provided to understand the inventive features of the present invention. It shall be apparent to one skilled in the art, however that this invention may be practiced without such specific details. Some of the details may not be described at length so as not to obscure the invention. For ease of reference, common reference numerals will be used throughout the figures when referring to the same or similar features common to the figures.

10 [0022] FIG. 1 illustrates an overall setup of a coolant mixture system **100** in accordance with an embodiment of the present invention. The coolant mixture system **100** adapted to automate the preparation of a coolant mixture, typically for use in CNC machining processes. More specifically, the coolant mixture system **100** is fluidly connected to two inflow pipes: one leading from a water source **20** and the other from a coolant tank **10**. The system **100** facilitates the discharge of a mixture of desired ratio of coolant and water into a mixture tank **30**, where it is subsequently stored for use. The coolant mixture system **100** comprises a wave generator **102**, a controllable valve **105**, a Venturi pump **108**, and a controller **110**.

20 [0023] Without limitations, the coolant tank **10** contained concentrated coolant that required dilutions for actual usage on the CNC machine, for example. Such concentrated coolant is most diluted with water or the like. The coolant mixture system **100** is adapted to perform mixing and diluting of the coolant.

[0024] The controller **110** is an electronic device that provides central control of all the operations of the system. The controller **110** is ingeniously programmed to manage the flow and mixture of coolant by orchestrating the operation of several key components to perform the mixing and operations. The controllable valve **105** is
 5 connected electrically or electronically such that the controller **110** precisely regulates flow of incoming water from the water source **20** through the controllable valve **105**. The controllable valve **105** also turn on and off the water supply. The outlet of the controllable valve **105** is further fluidly connected to the Venturi pump **108**.

10 **[0025]** The Venturi pump **108** comprises two inlets and one outlet for mixing two incoming fluids therethrough. It utilizes the Venturi effect by channelling a pressured fluid through a converging section into a narrow throat, where the velocity increase creates a vacuum that draws a secondary fluid into the flow. The combined fluids then pass into a diverging section, where the velocity decreases, and pressure recovers,
 15 enabling the onward movement of the mixture. In the present case, one of the inlet is connected to the controllable valve **105** for receiving water from the water source **20** and the other inlet is connected to fluid pipe from the coolant tank **10**.

[0026] The Venturi pump **108** is provided as a mixing pump that receives two or
 20 more liquid of different kind, mixes them at a ratio of intended therein, and dispenses the mixed fluid. The advantage of selecting Venturi pump **108** is that it typically has no moving parts, it is valued for its simplicity and reliability. In one embodiment, Venturi pump **108** may be adjustable to control the mixing ratio. Either way, once flow ratio is fixed on the pump **108**, no further adjustment is needed.

[0027] In an alternative embodiment, other pumps or fluid mixing means known in the art can also be used. One example is dosing pumps, also known as metering pumps can also be used for precisely controlling the volume of fluid delivered through the
5 coolant mixing system **100**.

[0028] A further alternative is the use of static mixers whereby mix fluids passes through a series of fixed elements within a pipeline to achieve mixing.

10 [0029] Further electrically connected to the controller **110** is the wave generator **102** which is adapted to dispose within the mixture tank **30**. The wave generator **102** serves as an agitator placed within the mixture tank **30**. The wave generator **102** is activated by the controller **110** to create a turbulent motion within the mixture tank **30**, facilitating a thorough and efficient mixing of the coolant with water. The controller **110**
15 adjusts the operation of the wave generator **102** based on various parameters such as mixture consistency, ensuring an optimal blend. The operations of the wave generator **102** includes turning on, turning off, speed control, etc.

[0030] In FIG. 1, there are provided the directional arrows to signify the flow of
20 the fluids operationally: when the controllable valve **105** is opened, water from the water source **20** flows through the controllable valve **105** and the coolant is drawn from the coolant tank **10** are channelled into the respective inlet of the Venturi pump **108**, and mixing therethrough, then entering the mixture tank **30** where the wave generator **102** is disposed/installed. As and when needed, the wave generator **102** can be activated by the
25 controller **110** to help keeping the mixture well mixed. When needed, the mixed coolant

is pumped out by an external pump **40** into a transport trolley **60** so that the mixed coolant can be transported to top up CNC machine.

[0031] The system **100**, with its controller **110** as the pivotal component,
5 embodies a significant advancement in the automation of coolant preparation for CNC machines. The integration of the controller with the controllable valve **105**, the wave generator **102**, and the Venturi pump **108** showcases the inventive step that distinguishes this system from existing technologies. This integration ensures a seamless, efficient, and reliable coolant mixing process, setting a new standard for industrial fluid
10 management.

[0032] In yet a further embodiment, the controller **110** is envisioned as a smart, network-connected device, equipped with capabilities to communicate with other smart devices over a network for enhanced monitoring and control of the coolant mixture
15 system. This smart controller could interface with a communication network or cloud-based services, allowing for remote access to system diagnostics, operational status, and performance analytics. Through this connectivity, the smart controller **110** could receive updates for process optimization, predictive maintenance alerts, and even automate ordering of supplies like coolant concentrate and or flow rate/ratio.

20 **[0033]** Additionally, the controller **110** could be integrated with a plant-wide management system, enabling it to synchronize with other smart machinery and sensors. It would facilitate a cohesive operation where data on coolant usage, temperature, flow rates, and mixture quality can be shared in real time. This integration allows for a
25 centralized control point, which can automatically adjust the coolant mixture parameters

based on feedback from CNC machines, ensuring optimal performance and reducing downtime. By leveraging machine learning algorithms, the controller **110** could predictively adjust mixing ratios to compensate for changing operational conditions, such as variations in ambient temperature or machine load.

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[0034] This detailed description of the invention encapsulates the advanced engineering and thoughtful design that underpin the coolant mixture system **100**. The present invention not only enhance the system's efficiency but also underscore the inventive step that distinguishes this system from conventional coolant mixing methods.

10 The present invention promises to deliver significant improvements in terms of operational efficiency, mixture quality, and reliability in industrial machining environments.

[0035] FIG. 2 illustrates a block diagram of a coolant mixture system **200** in accordance with an alternative embodiment of the present invention. The coolant mixture system **200** comprises a controller **202**, a controllable valve **204**, a mixture pump **206**, and an agitator **208**. The controller **202** is a central processor that receives signals/data and process the same and react as necessary to perform the operations. The controller **202** is connected to the controllable valve **204** and the agitator **208** to control them operationally.

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[0036] Depending on the type of mixing pump **206** adopted, the controller **202** may connect thereto to control its operations in conjunctions with the controllable valve **204**. In the case FIG. 1, the mixing pump **206** is a Venturi pump that does not require any external means to control its operation. Hence, no connection is needed with the mixing pump **206**. In another embodiment, the controller **202** may connect to the mixing pump **206** to control the mixing operations within the pump.

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[0037] In another embodiment, the coolant mixture system **200** may further the implementation of a diverse array of sensors **212** can be strategically employed across the system to enhance monitoring and ensure precision in the coolant mixture process.

5 Taking FIG. 1 for example, flow sensors **212**, integral to the system's efficiency, can be installed both at the coolant tank **10** outlet of the Venturi pump **108** and at the water source **20** inlet of the controllable valve **105**. These sensors are essential for monitoring and regulating the flow rates, providing data to the controller **110** to maintain the proper coolant-to-water ratio. In other embodiments, temperature sensors can be adopted,
10 tasked with ensuring the coolant mixture maintains a temperature conducive to optimal machine operation, thereby safeguarding the machinery from thermal shocks or overheating.

[0038] In yet further embodiment, the integration of pH sensors may serve to
15 perpetually monitor the mixture's pH levels. In yet another example, conductivity sensors would measure the electrical conductivity of the coolant, offering insights into the concentration of dissolved solids and allowing for the early detection of contaminants that could compromise the cooling and lubrication properties. These sensors collectively contribute to a holistic overview of the system's operation, enabling the controller **110** to
20 make informed, automated adjustments to various system components, ensuring the coolant mixture is consistently within specified parameters for quality and performance.

[0039] In yet another embodiment, the controller **202** may be facilitated with smart technology that can communicate with remote communication devices **220** for
25 enhanced capability. In such case, the system may further comprise a communication

module allowing the system be monitored and controlled remotely. The system operation parameters can be transmitted to remote device **220**. Through the remote device **220**, the system can be monitored controlled accordingly.

- 5 **[0040]** While specific embodiments have been described and illustrated, it is understood that many changes, modifications, variations and combinations thereof could be made to the present invention without departing from the scope of the invention.

Claims

1. A coolant mixture system for preparing a coolant mixture for use in industrial CNC machine, the coolant system comprising:
 - a controller configured to regulate operations of the coolant system;
 - 5 a controllable valve connected to the controller electrically, the controllable valve further in fluid communication with a water source, wherein the controller operationally adjusts the flow of water from the water source based on signals from the controller; and
 - a mixture pump having one inlet fluidly connected to the controllable valve for receiving water operationally, and the other inlet fluidly connected to a coolant source
 - 10 for receiving both water and coolant to be mixed therein, wherein the mixture pump has an outlet to discharge mixture fluid into a mixture tank.
2. The coolant mixture system according to claim 1, further comprises an agitator electrically connected to the controller, wherein the agitator is adapted to dispose within
- 15 in the mixture tank while maintaining communications with the controller, wherein the wave generator is configured to agitate the mixture.
3. The coolant mixture system according to claim 1, wherein the mixture pump is a Venturi pump, the Venturi pump is configured to draw coolant into the mixture tank
- 20 using a pressure differential created by the water flow.
4. The coolant mixture system according to claim 1, wherein the agitator is a wave generator.

5. The coolant mixture system according to claim 1, wherein the agitator is activated in a periodic manner.
6. The coolant mixture system according to claim 1, further comprising a plurality of sensors, wherein the controller is further configured to receive input from the sensors and to adjust the operation of the controllable valve, the wave generator, and the mixture pump based on the input from the sensors to maintain a predetermined ratio of coolant to water in the coolant mixture.
7. The coolant mixture system according to claim 1, wherein the controller is a smart controller and further communicable with computer network, wherein the coolant mixture system can be monitored and controlled remotely through handheld communication devices.
8. A coolant mixture tank comprising a coolant mixture system of any of Claim 1-7 for drawing a concentrated coolant and at least one diluting liquid into said tank.
9. The coolant mixture tank of claim 8, further comprising a pump for dispensing coolant mixture from the coolant mixture tank into a transporting tank.