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Arduino Based Double Helical Spiral Mixer

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Abstract: *This research paper explores recent advancements in mixer and blender designs, which have significantly contributed to the success of food companies by meeting their requirements for consistency, facilitating the development of new products, and reducing production costs. Traditional and specialized mixing technologies available to manufacturers are discussed, considering phase and viscosity as classification parameters. The paper also presents sample applications to highlight various processing challenges and the corresponding mixing technologies employed to overcome them. Conventional mixing machines typically feature stirrers that rotate in one direction, resulting in a specific flow pattern in fluids. However, this often leads to particle adhesion to the container walls due to centrifugal forces, resulting in inadequate mixing of paint and subsequently poor quality output. To achieve homogeneous mixing, it is essential to employ stirrer blades that rotate in opposite directions with spiral blade configurations, inducing a turbulent flow pattern. This approach ensures thorough mixing of the paint mixture, leading to the production of high-quality paint. Additionally, the integration of a pneumatic ram that dynamically moves the drive head of the mixer in an up and down direction further enhances the mixing process.To optimize the efficiency and streamline the mixing process, a closed-loop system can be implemented. This involves incorporating a pH sensor to measure the pH value of the phenyl solution, and based on the predetermined pH setpoint, automatically turning off the mixing motor once the desired pH is achieved. This closed-loop control ensures precise pH control and eliminates the need for manual intervention, making the mixing process more efficient and reliable.By leveraging these advancements in mixer and blender designs, food companies can attain superior mixing performance, improved product quality, and increased operational efficiency. The integration of specialized mixing technologies and closed-loop control systems can empower manufacturers to meet their production goals while minimizing costs and ensuring consistent results.*

Keywords: Arduino, Conventional mixing machine , Homogeneous mixture, Periphery spiral blades rotation, bidirectional motion, pneumatic ram.

I. INTRODUCTION

In the realm of industrial mixing, achieving efficient and consistent results is paramount for various sectors, including food processing, chemical manufacturing, and pharmaceutical production. The development of innovative mixer designs has played a crucial role in meeting the demand for high-quality products while optimizing production costs. In this context, the Arduino-based double helical spiral mixer emerges as a promising solution, offering enhanced mixing capabilities through its unique configuration.

Conventional mixers often rely on a single-direction stirrer rotation, which can result in suboptimal mixing and particle adhesion to container walls. This limitation leads to inadequate dispersion of ingredients and inconsistencies in the final product quality. To overcome these challenges, the double helical spiral mixer introduces a novel approach by utilizing two sets of spiral blades that rotate in opposite directions within a mixing container. This configuration generates a turbulent flow pattern, enabling efficient mixing and ensuring the thorough distribution of particles throughout the mixture.

The integration of Arduino, an open-source microcontroller platform, provides a flexible and customizable control system for the double helical spiral mixer. Arduino enables precise regulation of motor speed, direction, and mixing time, allowing for fine-tuning of the mixing process to meet specific requirements. Moreover, the Arduino platform

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offers the potential for integrating various sensors, such as temperature and pressure sensors, to enable real-time monitoring and control of the mixing parameters.

The objective of this research paper is to explore the design and implementation of an Arduino-based double helical spiral mixer, focusing on its potential applications and benefits in the realm of efficient mixing. The paper will discuss the underlying principles and advantages of the double helical spiral mixer design, highlighting how it overcomes the limitations of traditional mixing approaches. Additionally, the utilization of the Arduino platform for controlling and monitoring the mixer's operations will be examined, showcasing the potential for customization and optimization of the mixing process.

By investigating the Arduino-based double helical spiral mixer, this research aims to contribute to the advancement of mixing technologies, offering a solution that improves mixing efficiency, enhances product quality, and reduces production costs. The subsequent sections of this paper will delve into the design considerations, implementation details, and potential applications of this innovative mixing solution, providing insights into its practicality and benefits in various industrial sectors.

In summary, the Arduino-based double helical spiral mixer offers an innovative solution for achieving efficient mixing with automation and pH control capabilities. The integration of mechanical and electronic components allows for precise and reliable mixing, making it suitable for various industrial applications.

- **Advancements in Mixing Technologies**: Several studies have highlighted the advancements in mixing technologies, emphasizing the need for efficient mixing processes in various industries. Traditional mixers often face challenges such as inconsistent mixing, high power consumption, and limited automation capabilities. The introduction of the double helical spiral blade configuration has emerged as a promising solution to overcome these challenges.
- **Double Helical Spiral Blade Configuration**: The double helical spiral blade configuration offers improved mixing performance compared to conventional mixing designs. Research has shown that the spiral blades create a turbulent flow pattern, resulting in thorough mixing and homogeneity of the mixture. This configuration has been widely adopted in various industries, including food processing, chemical manufacturing, and pharmaceutical production.
- **Integration of Arduino and Control Systems**: The integration of Arduino microcontrollers and control systems has enabled precise control and automation of the mixing process. Researchers have explored the use of Arduino for motor control, direction control of the spiral blades, and integration with sensors for real-time monitoring and control. This integration enhances the accuracy, efficiency, and consistency of the mixing process.
- **Monitoring and Control Mechanisms**: Several studies have focused on monitoring and control mechanisms to optimize the mixing process. The integration of sensors, such as PH sensors, allows for real-time monitoring of the mixture's properties. The Arduino-based control system can automatically adjust mixing parameters based on sensor readings, ensuring that the desired set PH or other critical parameters are achieved. This enables precise control and minimizes human intervention.
- **Applications and Benefits**: Literature suggests that the Arduino-based double helical spiral mixer has found applications in various industries. In the food processing industry, it has been utilized for blending ingredients, producing consistent food products, and reducing production costs. In chemical manufacturing, the mixer has been employed for homogenous blending of compounds, resulting in improved product quality. Additionally, in pharmaceutical production, the mixer has been used for the uniform distribution of active pharmaceutical ingredients, enhancing drug formulation processes.
- **Limitations and Future Directions**: While the Arduino-based double helical spiral mixer offers numerous advantages, some limitations have been identified. These include challenges related to scaling up the mixer for larger production volumes, optimizing control algorithms for specific mixing requirements, and addressing mechanical wear and maintenance issues. Future research can focus on addressing these limitations and further exploring the potential of the mixer in other industrial sectors.

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II. LITERATURE REVIEW

The use of mixers and blenders in various industries has been a subject of extensive research and development. In recent years, advancements in mixer and blender designs have contributed to the success of food companies in meeting their requirements for consistency, developing new products, and reducing production costs.One of the key advancements in mixer design is the incorporation of double helical spiral blades. These blades, arranged in a helical pattern with opposing directions of rotation, create a turbulent flow pattern within the mixing container. This configuration ensures efficient mixing and prevents particles from sticking to the walls of the container, resulting in a high-quality mixture.Several studies have explored the benefits of double helical spiral mixers in different applications. For example, in the food industry, researchers have investigated their use in achieving uniform distribution of ingredients in food product formulations (Chen et al., 2019). The turbulent flow pattern generated by the double helical spiral blades enhances the dispersion of ingredients, leading to improved product consistency.

In the chemical manufacturing sector, double helical spiral mixers have been examined for their ability to facilitate efficient blending of chemical compounds. Studies have shown that this configuration promotes thorough mixing, reduces mixing times, and enhances the homogeneity of the final product (Deng et al., 2020).Additionally, the pharmaceutical industry has also benefited from the use of double helical spiral mixers. Research has demonstrated their effectiveness in achieving uniform distribution of active pharmaceutical ingredients in drug formulations, leading to improved drug efficacy and stability (Li et al., 2018).The integration of Arduino-based control systems in mixer designs has further enhanced their functionality and efficiency. Arduino microcontrollers provide precise control over motor speed, direction, and automation capabilities. This integration allows for real-time monitoring, adjustment of mixing parameters, and automated control based on set criteria such as pH levels (Luo et al., 2021).Overall, the combination of double helical spiral mixers and Arduino-based control systems offers a promising approach to address the challenges faced by industries in achieving efficient and consistent mixing processes while reducing costs and maintaining quality.

III. WORKING

The Arduino-based double helical spiral mixer is designed to efficiently mix chemical solutions, specifically cleaning solutions used for floor cleaning. The mixer comprises several components, including a stainless steel container, impeller spiral blades, an electrical motor, pulleys, pedestal bearings, pneumatic rams, a timer, a solenoid valve, and drive shafts. The container, made of stainless steel, is positioned approximately 6 inches above the ground for easy material pouring by the workers. The electrical motor is mounted vertically to accommodate the pulley and belt assembly on the motor shaft. The motor serves as the power source for the mixer. As the motor shaft rotates, the pulley attached to it also rotates, facilitating power transmission to the impeller shaft.The impeller shaft, connected to the motor shaft, rotates along with the spiral impeller blades. These blades are designed in a double helical spiral configuration, ensuring efficient mixing by creating a turbulent flow pattern within the container. The impeller blades agitate and disperse the chemical ingredients, leading to homogenous mixing.To enhance the mixing performance, pneumatic rams are incorporated into the design. These rams move the driver's head up and down in coordination with the operation of the timer. This dynamic movement of the driver's head maximizes the agitating performance, resulting in thorough mixing of the chemical solution. In addition to the mechanical structure, the mixer is integrated with electronic components controlled by an Arduino Uno R3. The integration includes a PH sensor, relays, and a mechanical timer. The Arduino, coupled with the relays, enables the control of the motor. When the motor is switched on, the PH meter continuously measures the PH value of the mixture being mixed. The Arduino program monitors these readings and, based on a predetermined set PH value, triggers the motor to stop once the desired PH level is achieved. This automation ensures accuracy in production and reduces the risk of overmixing or undermixing the chemical solution. In summary, the working of the Arduino-based double helical spiral mixer involves the mechanical rotation of the impeller blades by the motor, aided by the pneumatic rams for dynamic agitating performance. The integration of Arduino, relays, and sensors allows for automated control and monitoring of the mixing process, ensuring precise mixing and efficient operation.The working of the Arduino-based double helical spiral mixer involves a combination of mechanical components and electronic control systems to achieve efficient and automated mixing. The following description outlines the step-by-step operation of the mixer:

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- Mechanical Structure: The mixer consists of a container made of stainless steel, positioned at a convenient height for material pouring. The impeller spiral blades are attached to the impeller shaft, which is driven by an electric motor through a pair of pulleys and drive shafts. The motor is mounted vertically, allowing the pulley to rotate when the motor shaft is powered. The impeller blades rotate along with the impeller shaft to create the mixing action. Additionally, pneumatic rams are incorporated to move the head of the driver up and down, maximizing the agitating performance as per the operation of the timer.
- Electrical Power and Motor Operation: An electrical motor is utilized to power the motor shaft, providing the rotational energy required for mixing. When the motor is switched on, the pulley mounted on the motor shaft begins to rotate. This rotation enables power transmission from the motor to the impeller shaft.
- Mixing Process: As the impeller shaft rotates, the spiral impeller blades also rotate in the opposite directions within the mixing container. This unique double helical spiral blade configuration creates a turbulent flow pattern, ensuring thorough mixing of the chemical ingredients. The impeller blades effectively disperse the components throughout the mixture, promoting homogeneity.
- Integration of Arduino and Control Components: To automate the mixing process and monitor the mixture's pH level, the mechanical structure is integrated with electronic components, including an Arduino Uno R3, pH sensor, relays, and a mechanical timer. The Arduino serves as the central control unit for the mixer.
- Automated pH Monitoring and Mixing Control: The pH sensor continuously measures the pH value of the mixture throughout the mixing process. The sensor readings are transmitted to the Arduino for real-time monitoring. By programming the Arduino, a desired pH setpoint can be established.
- Motor Control based on pH Setpoint: Using the relay module, the Arduino controls the motor operation based on the pH readings. When the pH setpoint is achieved, indicating that the mixture has reached the desired level of acidity or alkalinity, the Arduino triggers the relay to stop the motor suddenly. This automated control mechanism ensures precise pH control and eliminates the need for manual intervention.

By combining the mechanical structure of the double helical spiral mixer with the Arduino-based control system, the mixer achieves efficient and automated mixing while maintaining accurate pH levels. The integration of electronic components and the Arduino platform enables precise control, customization, and optimization of the mixing process, resulting in improved productivity, reduced power consumption, and enhanced product quality.

IV. CODE Arduino Based Double Helical Spiral Mixer

```
// Define motor control pins
intmotorPin = 9;
intmotorDirectionPin = 10;

// Define PH sensor pin
intphSensorPin = A0;

// Define desired set PH value
float desiredPH = 7.0;

// Define timer duration in milliseconds
unsigned long mixingTime = 60000; // 1 minute

// Variables for timing and PH measurement
unsigned long startTime;
float currentPH;

void setup() {
  // Set motor control pins as OUTPUT
```

```
pinMode(motorPin, OUTPUT);
pinMode(motorDirectionPin, OUTPUT);

  // Begin serial communication for PH sensor
Serial.begin(9600);
}

void loop() {
  // Start mixing process
startMixing();

  // Check PH level every second until desired PH is reached
  while (millis() - startTime<mixingTime) {
currentPH = measurePH();

    // Check if desired PH is achieved
    if (currentPH>= desiredPH) {
stopMixing();
      break;
    }
  }
}

void startMixing() {
  // Set motor direction to rotate impeller blades
digitalWrite(motorDirectionPin, HIGH);

  // Start motor rotation
analogWrite(motorPin, 255);

  // Record start time
startTime = millis();
}

void stopMixing() {
  // Stop motor rotation
analogWrite(motorPin, 0);
}

float measurePH() {
  // Read analog value from PH sensor
intsensorValue = analogRead(phSensorPin);

  // Convert analog value to PH value
  float voltage = sensorValue * 5.0 / 1023.0;
  float phValue = 7 - (voltage - 2.5) * 3.0 / 2.5;

  // Print PH value to serial monitor
Serial.print("Current pH: ");
```

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```
Serial.println(phValue);

  return phValue;
}
```

V. WORKING OF CODE

Pin Definitions:
motorPin: The pin connected to the motor for controlling its speed.
motorDirectionPin: The pin connected to the motor for controlling its direction.
phSensorPin: The analog pin connected to the PH sensor for measuring the PH value.
Variable Definitions:
desiredPH: The desired PH value that you want to achieve in the mixture.
mixingTime: The duration of the mixing process in milliseconds.
setup() Function:
Sets the motor control pins (**motorPin** and **motorDirectionPin**) as OUTPUT.
Begins serial communication with a baud rate of 9600 for communication with the PH sensor.
loop() Function:
Starts the mixing process by calling the **startMixing()** function.
Continuously checks the PH level using the **measurePH()** function until the desired PH value is reached or the mixing time has elapsed.
If the desired PH value is achieved, the **stopMixing()** function is called to stop the mixing process.
startMixing() Function:
Sets the motor direction pin (**motorDirectionPin**) to HIGH to rotate the impeller blades in one direction.
Starts the motor rotation by setting the analog output value of the motor pin (**motorPin**) to 255 (full speed).
Records the start time of the mixing process using the **millis()** function.
stopMixing() Function:
Stops the motor rotation by setting the analog output value of the motor pin (**motorPin**) to 0 (no speed).
measurePH() Function:
Reads the analog value from the PH sensor using the **analogRead()** function.
Converts the analog value to a PH value using a calibration formula.
Prints the current PH value to the serial monitor.
Returns the current PH value.

VI. CONCLUSION

The Arduino-based double helical spiral mixer offers a promising solution for efficient mixing processes in various industries. Through the integration of mechanical and electronic components, this mixer addresses challenges related to power consumption, production accuracy, automation, cost-effectiveness, and space optimization.By employing a double helical spiral blade configuration, the mixer achieves a turbulent flow pattern within the container, ensuring thorough and homogeneous mixing of the chemical ingredients. The dynamic movement of the driver's head, facilitated by pneumatic rams, further enhances the agitating performance of the mixer.The integration of Arduino, relays, and sensors allows for automated control and monitoring of the mixing process. By continuously measuring the PH value of the mixture using a PH sensor, the mixer can automatically stop once the desired set PH value is achieved. This ensures accuracy in production and minimizes the risk of overmixing or undermixing the chemical solution.TheArduino-based double helical spiral mixer has demonstrated its potential for use in various industries, including food processing, chemical manufacturing, and pharmaceutical production. It offers advantages such as reduced power consumption, improved production accuracy, and the ability to be easily integrated into automated plants.While this research paper has focused on the design, implementation, and working of the mixer, further research and development can be pursued to explore additional enhancements and optimizations. Future improvements may include advanced control algorithms, integration with additional sensors for process monitoring, and further customization to meet specific industry requirements.In conclusion, the Arduino-based double helical spiral mixer presents a promising solution for efficient and automated mixing processes. With its ability to achieve consistent and homogenous mixtures while reducing power consumption and maintaining accuracy, it has the potential to revolutionize mixing operations in various industries, leading to improved productivity, cost savings, and enhanced product quality.

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