TITLE:

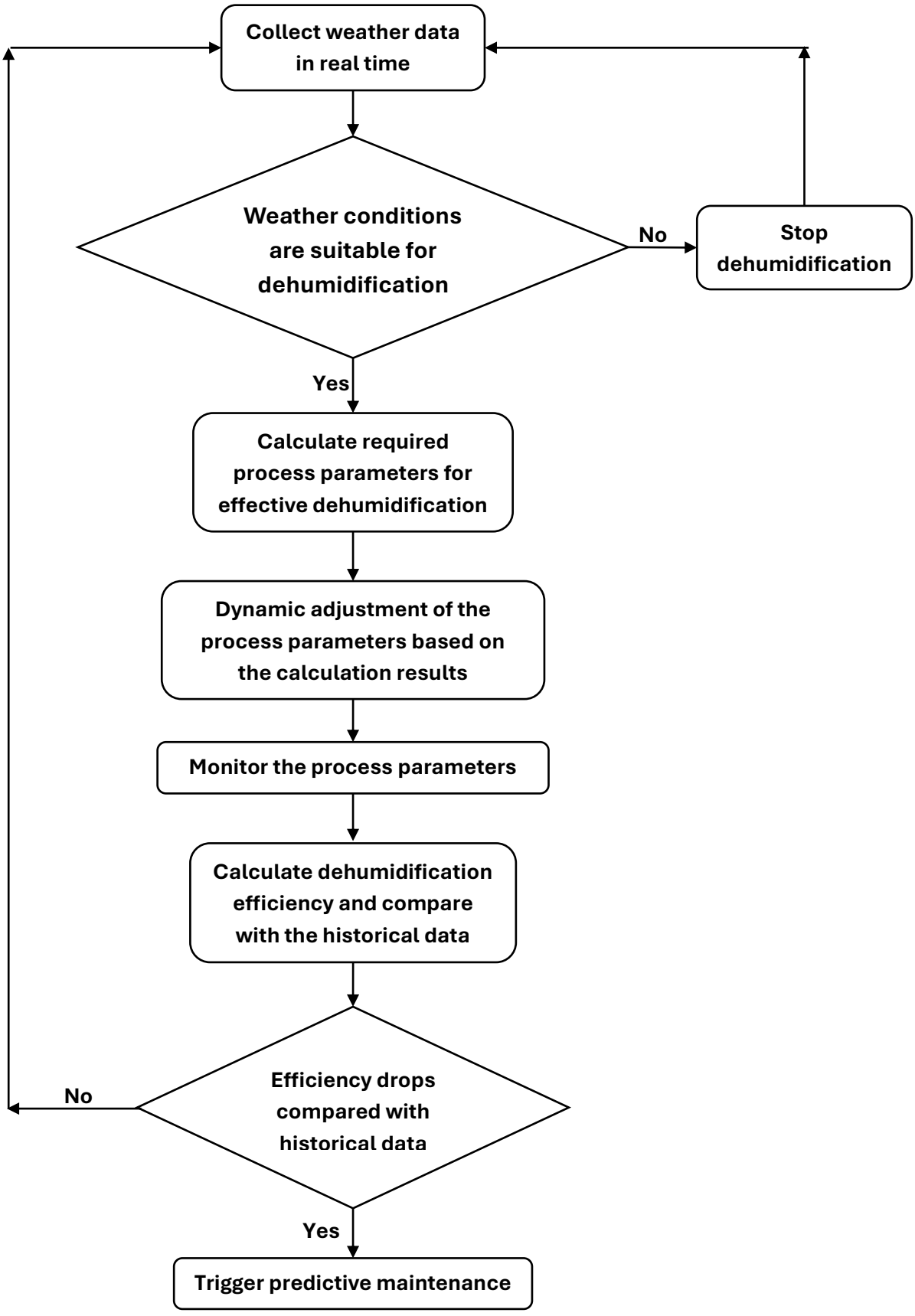
Optimization of the dehumidification process in real time based on changing weather conditions

Technical Notes

The control system is based on the following approaches:

1. **Real-Time Weather Monitoring:** The system utilizes sensors to gather real-time weather data, including but are not limited to temperature, pressure, and humidity.
2. **Algorithm-Driven Optimization:** The collected weather data is input into algorithms which calculate optimal process parameters. By analysing weather data fluctuations, the algorithm adjusts the process parameters including but not limited to air intake speed, coolant temperature and compressor power to balance effective dehumidification performance and energy efficiency.
3. **Safety Assurance:** Critical system parameters, such as compressor suction line conditions, are continuously monitored to maintain superheat states. This prevents component failure and ensures the long-term integrity of the system.
4. **Predictive Maintenance:** The system monitors and analyses process parameters including but not limited to power consumption and pressure to detect system leakage, trigger predictive maintenance like system cleaning and coolant top up. These proactive measures minimize downtime and extend system lifespan.
5. **Weather-Condition-Based Operations:** When weather conditions are unsuitable for dehumidification, including but not limited to low humidity or freezing temperatures, the system automatically shuts down dehumidification process to save energy. It restarts when weather conditions meet predefined parameters, ensuring consistent and efficient operation.

A flow chart for the optimization of the dehumidification process in real time:



BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a system diagram, a visual representation of optimizing the dehumidification process in real time based on changing weather conditions.

Fig. 2, illustrates a clean drawing of the system without labels and reference numerals.

DETAILED DESCRIPTIONS

Fig. 1 is a system diagram of one embodiment of the present invention as an optimization process for dehumidification in real time, containing a data acquisition system, dehumidification system, and a data processing and analysis system.

The data acquisition system which is configured to measure and collect real time weather data through sensors include, but are not limited to, a temperature sensor 1, a dew point sensor 2, and a humidity sensor 3, which are all connected to the microprocessor 16 in the control box 15.

The dehumidification system configured to remove moisture from the air with real time system data collection through sensors including, but not limited to, a condenser 4, an evaporator 5, a compressor 6, an expansion valve 7, a fan 8, a temperature sensor 9 before the evaporator 5, a temperature sensor 10 after the evaporator 5, a pressure sensor 11 before the compressor 6, a pressure sensor 12 after the compressor 6, a water collection tank 13, and a hydrostatic pressure sensor 14.

The data processing and analysis system which holds and executes one or more algorithms consists of, but is not limited to a control box 15 which may include, but are not limited to a microprocessor 16 and an energy meter 17. The algorithm is configured to process the acquired parameters, including but not limited to weather conditions such as humidity and temperature, energy consumption and water generation and evaluate the dehumidification conditions to predict optimal output parameters for optimized dehumidification process.

The processed data is then programmed into the compressor 6 and expansion valve 7 which are adjusted by closing or opening the expansion valve 7, and increasing or decreasing the compressor 6 speed, to optimize the dehumidification process.

In certain embodiments, the optimization process illustrated in Fig. 1 operates in a closed-loop configuration, wherein feedback from the data acquisition system and dehumidification system are continuously analyzed by the algorithm in the data processing and

analysis system, to predict adjustments to be made to the process parameters— compressor 6 and expansion valve 7 to optimize dehumidification in real time based on changing weather conditions

Although the present invention has been described with reference to preferred embodiments, those skilled in the art will recognize that various modifications, substitutions, and changes in form and detail may be made without departing from the spirit and scope of the invention as defined by the appended claims.

Referring now to Fig. 2, illustrates a clean drawing of the system without labels and reference numerals.

CLAIMS

1. A system for optimization of a dehumidification process in real time based on changing weather conditions, the system comprising:
    a. a data acquisition system to receive real-time environmental data including but not limited to temperature, dew point, and humidity;
    b. a dehumidification system functioning as moisture remover and water collector;
    c. a data acquisition system for the dehumidification process to receive real-time system data including but not limited to temperature, pressure, energy, and hydrostatic pressure;
    d. a data processing and analysis system comprising one or more algorithms configured to analyze and calculate process parameters, including but not limited to expansion valve opening and compressor speed, based on data from the data acquisition system and data from the dehumidification system.
2. The system of claim 1, wherein the data acquisition system is configured to collect data continuously or at predefined intervals.
3. The system of claim 1, wherein the algorithm is a self-learning algorithm that refines process parameters based on historical performance.
4. The system of any preceding claim, wherein the data acquisition system communicates with the data processing and analysis system via a wired or wireless connection.
5. The system of any preceding claim, wherein the dehumidification system communicates with the data processing and analysis system via a wired or wireless connection.
6. The system of any preceding claim, wherein the data-processing and analysis system predicts optimal process parameters to pre-emptively adjust process parameters.
7. The system of any preceding claim, wherein the data-processing and analysis system adjusts process parameters to maintain superheat condition at the compressor suction line.
8. The system of any preceding claim, wherein the dehumidification system is configured to suspend operation when ambient humidity falls below a predefined threshold and to resume when conditions return to suitable levels.
9. A method for optimization of a dehumidification process in real time based on changing weather conditions, the method comprising:

a. collecting, via one or more sensors, real-time weather data comprising at least one of temperature, dew point, humidity, and additional environmental parameters;
b. collecting, via one or more sensors, real-time system data comprising at least one of temperature, pressure, energy, hydrostatic pressure, and additional operational parameters;
c. inputting the collected data into one or more customized algorithms configured to operate in a real-time environment;
d. calculating process parameters, including but not limited to, expansion valve opening position and compressor speed using one or more customized algorithms;
e. adjusting said process parameters in the compressor and expansion valve to optimize dehumidification efficiency;
f. adjusting said process parameters in the compressor and expansion valve to maintain superheat condition at compressor suction line;
g. determining when weather conditions are unsuitable for dehumidification, through one or more customized algorithms analyzing including but not limited to low humidity or freezing temperatures, and suspending the process accordingly; and
h. automatically restarting the dehumidification process when weather conditions meet predefined operational parameters.

10. The method of claim 9, wherein the weather and system data are collected continuously or at predefined intervals.
11. The method of claim 9, further comprising monitoring energy consumption and water generation to refine the algorithm over time.
12. The method of any preceding claim, wherein the algorithm utilises predictive modelling based on weather data, system data, and historical performance data.
13. An apparatus for optimization of a dehumidification process in real time based on changing weather conditions, the apparatus comprising:
    a. a data acquisition system comprising one or more sensors configured to collect environmental data, including but not limited to temperature, humidity, and dew point;
    b. a dehumidification system comprising one or more condenser, evaporator, compressor, expansion valve, and fan;

c. a data acquisition system for the dehumidification system comprising one or more sensors configured to collect system data, including but not limited to temperature, pressure, energy, and hydrostatic pressure;
d. a data processing and analysis system comprising one or more control box with compressor and energy meter, one or more microprocessors incorporating one or more algorithms configured to:
    i. receive weather data from sensors in real time;
    ii. receive system data from sensor in real time;
    iii. calculate optimal process parameters.