MATHEMATICAL MODEL OF THE ENERGY AND TEMPERATURE-HUMIDITY PROCESSES IN A STOCK-BREEDING FARM WITH DOSED DISTRUBUTED INFLOW OF AIR
PART 2. ALGORITHMS

EVSTATIEV IVAN[1], MIHAILOV NIKOLAY[2*], GEORGIEV GEORGI[3], EVSTATIEV BORIS[4]

Angel Kunchev University of Rousse, Studentska str. №8, Rousse 7017, Bulgaria,
[1]Dept. of Electrical Power Supply and Equipment,
[2]Dept. of Electronics,
[3]Dept. of Computer Systems and Technologies,
[4]Dept. of Theoretical and Measuring Electrotechnics

Abstract: Modelling the progress of air stream parameters in space and time as applied to a stock-breeding farm is a basis for implementing higher quality microclimate control, based on modern information technology, using powerful mathematical models. It permits, through simulation of control processes and the progress of microclimate parameters within a farm's space, for a given combination of conditions, to choose parameters of control in a way to provide the best conditions for the animals in their inhabited zone, while making the most efficient use of energy, emitted within the premises. Such an approach to microclimate control improves the energy efficiency of the process.
This paper aims at algorithmic modelling of different physical processes, represented as separate subroutines, describing the processes within a stream of air, fed into a stock-breeding premise.

Keywords: mathematical model, inflow of air, distributing, algorithms.

1. STREAM TRAJECTORY

The trajectory is determined on the basis of relations, defined in similarity theory and stream theory. An isothermal, flat, horizontal stream is considered [2]. The algorithm is presented on Figure1.

Relation (1) calculates the Archimedes criterion, set in (2), by means of which an approximation of the coordinates of the air stream's axis are determined. Equations (3), (4) and (5) define the running values of variation of Δy, Δl and l respectively, while (6) defines the current width of the stream.

2. MASS AND GEOMETRICAL CHARACTERISTICS OF THE STREAM

The relation for the inductance coefficient of volume capacity from stream theory is used. The characteristics are a function of the stream axis' length l, applied to the variation of the x axis. The algorithm is presented on Figure 2.

* Corresponding author, email: mihailov@ru.acad.bg

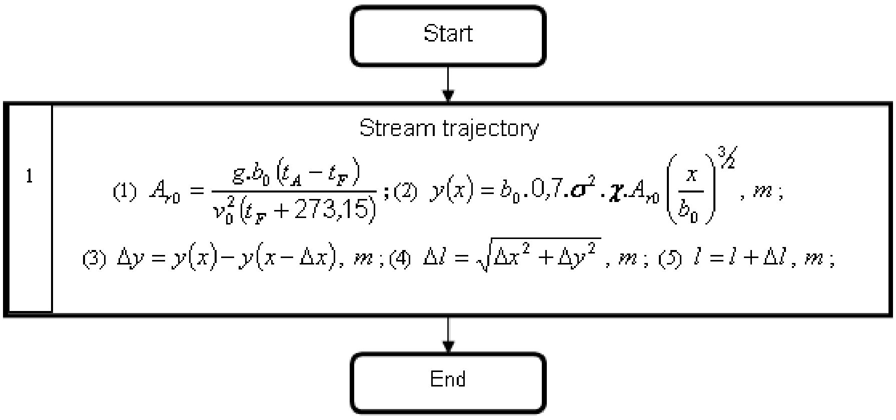

Fig. 1. Algorithm for describing the stream trajectory.

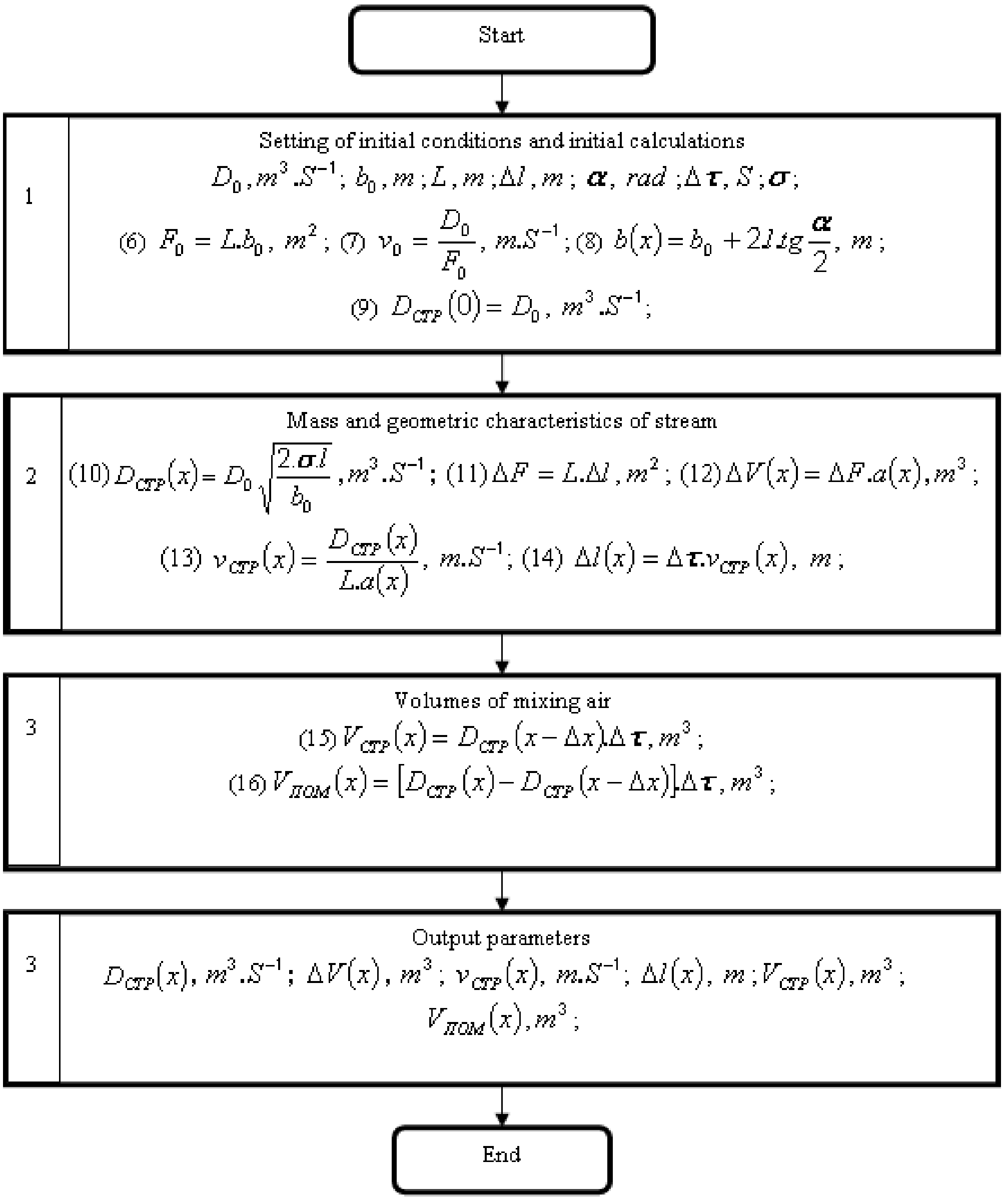

Fig. 2. Mass and geometrical characteristics of the stream.

Block 1 sets the input parameters and makes initial calculations. Relations (6) and (7) respectively determine the area and velocity in the section of outflow, (8) – the current width of the stream, (9) – defines the initial value for the array, used for determining the running stream capacity.

3. ENERGY EXCHANGE WHILE MIXING HUMID AIR STREAMS

Block 1 sets the input parameters and makes initial calculations - partial pressure, humidity contents, enthalpy and density of air streams (Figure 3.). Block 2 determines the current parameters of the stream, while block 3 calculates the air parameters after the streams have mixed.

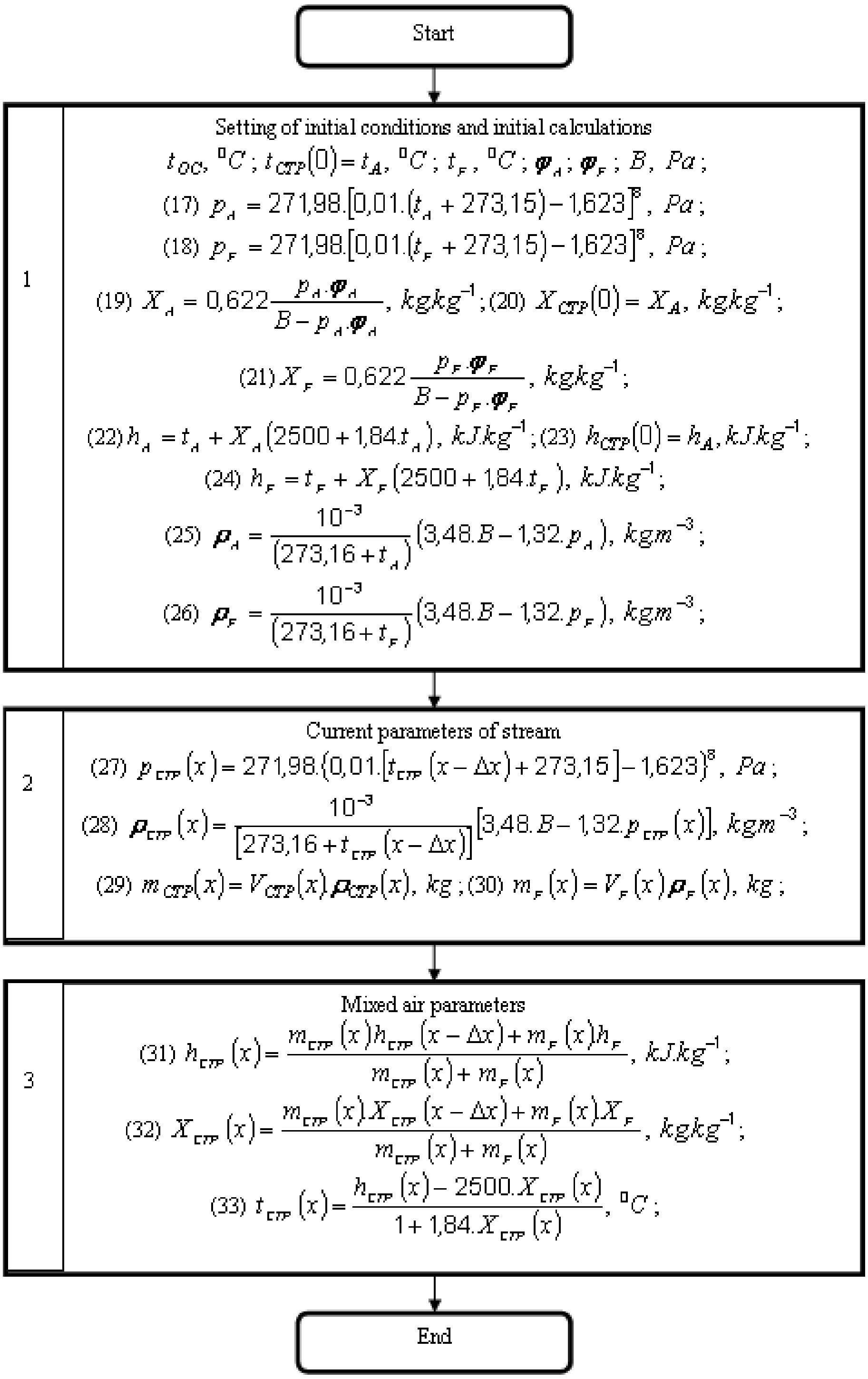

Fig. 3. Mixing of humid air streams.

4. CONCLUSION

Algorithms have been synthesized, which describe the processes within a moving air stream, applied to a stock-breeding farm, using distributed dozed feeding in of fresh air.

The algorithms describe the process in real-time and within the space of the premises, thus they are suitable for control of microclimate processes within a farm.

REFERENCES

[1] Velev, D. Technical Thermodynamics and Heat Transfer, Tehnika, Sofia, 1984.
[2] Stamov, St., Reference Book on Heating, Ventilation and Acclimatisation. Part I. Fundamentals of Heating and Ventilation, Tehnika, Sofia, 1990.
[3] Holman, P.J., Lloyd, J.R., Fundamentals of Engineering Thermodynamics, International Edition, 1992.

LIST OF ACRONYMS	
$b(x)$	Current width of air stream, m ;
A_{r0}	Archimedes criterion for the initial section;
b_0	Width of the inflow section, m ;
B	Atmospheric pressure, Pa ;
D_0 , $D_{CTP}(x)$	Stream capacities - at the start section and current, $m^3.S^{-1}$;
F_0 , ΔF	Area of stream's section at start and its increment, m^2 ;
l , Δl	Current value of the stream's axis and its discrete increment, m ;
L	Length of the section of outflow, m ;
h_A , h_F	Enthalpy in the stream's start and in the farm, $kJ.kg^{-1}$;
g	Earth's acceleration, $m.s^{-2}$;
$m_{CTP}(x)$, $m_F(x)$	Current mass of the air within and outside the stream, kg ;
v_0 , $v_{CTP}(x)$	Velocity of fluid outflow at the initial section and it current value, $m.s^{-1}$;
V_0 , V_X , $V_{CTP}(x)$, $\Delta V(x)$, $V_F(x)$	Volume capacities of the stream at the outflow section, at distance x from the outflow section, its current value, its increment and the current volume entering the stream from the farm, $m^3.s^{-1}$;
$V_{ПОМ}(x)$	Current volume, entering the stream from the premises, $m^3.s^{-1}$;
p_A , p_F , $p_{CTP}(x)$	Partial pressure of water vapours for saturated air at the stream start, in the farm and its current value in the stream, Pa ;
t_{OC} , t_A , t_F , $t_{CTP}(x)$	Air temperature of the environment outside the premises, at the stream start, in the farm and its current value, ^0C ;
χ	Coefficient of temperature variation;
h , h_1, h_2 , h_{SM}	Enthalpy of humid air, of mixing volumes and after mixing, $kJ.kg^{-1}$;
x , y	Space coordinates, m ;
Δx , Δy	Increment of coordinates, m ;
X_A , X_F	Absolute humidity contents at the stream start and in the farm, $kg.kg^{-1}c.в.$;
α	Angle of expansion of stream $\alpha = 0.57$, rad ;
φ , φ_A , φ_F	Relative humidity at the stream start and in the farm;

ρ , ρ_A , ρ_F , $\rho_{CTP}(x)$	Air density at the stream start, in the farm, and its current value, $kg.m^{-3}$;
σ	Coefficient of velocity variation;
τ , $\Delta\tau$	Current time and its increment, s ;