When coal is mined, a large quantity of gas is emitted from the walls of the face, and eventually work is brought to a halt. Various gas-suppression schemes have been developed. One of these is preliminary degassing of the district being worked [1]. For this purpose the solid coal is drained by a number of boreholes. On the basis of the analogy established between the movement of a gas current in a porous medium and that of an incompressible liquid, from the viewpoint of the nonlinear theory of filtration we have solved the problem of inflow of gas to an infinite system of boreholes drilled in a seam, and of gas filtration in a coal seam with markedly variable geometry.

1. Steady filtration of gas from a coal mass was examined in [2] from the viewpoint of the planar quasilinear theory of filtration. Subsequently field investigations in a coal field [3] revealed that gas may flow into mine working under conditions when the linear law of filtration is violated. The equations representing movement for the nonlinear law are as follows:

\[ \text{div} \rho \mathbf{w} = 0, \]  
\[ -\nabla p = \frac{\Phi(w)}{w} \mathbf{w}, \]  
\[ \rho = \rho(p), \]

where \( \rho \) is the density of the gas, \( \mathbf{w} \) is the velocity vector, \( p \) is the gas pressure, and \( \rho = \rho(p) \) is the equation of state.

The form of the function \( \Phi(w) \) in Eq. (2) is determined from experimental data. Equation (1) is satisfied identically if we introduce the function of the current \( \psi(x, y) \) from the equations

\[ \rho u = \psi_x, \quad \rho v = -\psi_y, \]

where \( u \) and \( v \) are the velocity components. Substituting (4) into (2), we get a system of differential equations of the form

\[ p_x = -\frac{\Phi(w)}{w} \frac{1}{\rho} \psi_y, \]
\[ p_y = -\frac{\Phi(w)}{w} \frac{1}{\rho} \psi_x. \]

We now introduce the function \( P(p) \) by the equation

\[ P(p) = \int_{p_*}^{p} \rho(p) \, dp, \]

which is similar to the Leibeznon function. Here \( p_* \) is a certain characteristic pressure.
In conjunction with (6), Eqs. (5) are written as equations representing the filtration of an incompressible liquid:

\[ p_x = -\frac{\Phi(w)}{w} \psi_y, \]
\[ p_y = \frac{\Phi(w)}{w} \psi_x. \]

This established the formal agreement between the movement of gas with an equation of state \( p = \rho(p) \) and the flow of an incompressible liquid, for which we selected the function \( P \) as the pressure. Using this analogy and selecting as independent variables \( w, \Theta \) (where \( \Theta \) is the slope of the velocity vector towards the axis of abscissas), we get the following system of equations for the functions \( p(w, \Theta), \psi(w, \Theta) \):

\[ \psi_w = -\frac{\Phi}{\Phi_w^2} P, \quad \left( \Phi = \frac{d\Phi}{dw} \right), \quad \rho = \rho(p(P)), \]
\[ \frac{d}{dP} \left( \frac{1}{w} (P\psi_w - P_w \psi_\Theta) \right) + \frac{1}{\Phi} P_w - \frac{1}{w^2} \psi = 0, \]

which by introducing the variable \( \sigma(w) \) and the potential function \( U(\sigma, \Theta) \) from the equations

\[ d\sigma = -\frac{\Phi}{\Phi^2} dw, \quad dU = \psi d\Theta + P d\sigma \]

is transformed to the Monge-Ampere equation (7)

\[ \frac{d}{dP} \ln \rho \left( U_{\sigma\sigma} U_{\Theta\Theta} - U_{\sigma\Theta}^2 \right) - a(\sigma) U_{\sigma\sigma} - b(\sigma) V_{\Theta\Theta} = 0, \]
\[ a(\sigma) = \frac{w}{\Phi}, \quad b(\sigma) = \frac{\Phi^2}{w^2}. \]

Knowing the solution of (E), the transition to the physical region of flow is effected by means of the known equation

\[ dz = d(x + iy) = \frac{1}{w} \left[ -\frac{w}{\Phi(w)} dP + i\Phi(w) \right] \frac{1}{\rho(P)}. \]

(7)

Using the fact that identity (7) is a perfect differential, we get in the variables \( (\sigma, \Theta) \) the conditions

\[ \frac{1}{w} - \frac{d}{d\sigma} \left( \frac{1}{\Phi} \right) = 0, \quad \frac{b(\sigma)}{w} - \frac{d}{d\sigma} \left( \frac{1}{w} \right) = 0, \]

which are automatically satisfied in the variables \( (w, \Theta) \).

**Particular Solution of Equation (E).** Let \( U(\sigma, \Theta) = \alpha \Theta^2/2 + \beta \Theta + f(\Theta) \), where \( \alpha \) and \( \beta \) are constants. Substituting this value of \( U(\sigma, \Theta) \) into (E), we get the following equation for \( f(\Theta) \):

\[ \alpha \frac{d}{dP} \ln \rho - a \frac{d^2 f}{d\sigma^2} - \alpha b = 0. \]

By means of (7) and solving \( U(\sigma, \Theta) \), we find the coordinates of the lines of flow \( \psi = U_\Theta = \alpha \Theta + \beta \) as

\[ x = \frac{\alpha}{\rho} \cos \Theta, \quad y = \frac{\alpha}{\rho} \sin \Theta. \]

Here, without restricting the generality, we get \( \beta = 0 \). It will be seen from the formulas that the streamlines in the physical plane are straight and pass through the origin, and that our solution represents gas flow from a source or outflow as a function of the sign of \( \alpha \).

In a general case, solution of the Monge-Ampere equation presents considerable mathematical difficulties.