





### 5. Some Physical and Geometrical Properties of the Models

For the model of equation (18), the other physical and geometrical parameters can be easily obtained. The expression for density is given by

$$\rho = \lambda = \left( \frac{L_4 e^{-\frac{\alpha(n+2)}{3(n-1)}t}}{[-m_1 e^{-\frac{\alpha(n+2)}{3(n-1)}t} + m_2]} + 1 \right) \frac{L_3 e^{-\frac{2\alpha(n+2)}{3(n-1)}t}}{[-m_1 e^{-\frac{\alpha(n+2)}{3(n-1)}t} + m_2]} + \frac{1}{L_2 [-m_1 e^{-\frac{\alpha(n+2)}{3(n-1)}t} + m_2] \frac{2(n-1)}{K}} \quad (21)$$

The coefficient of bulk viscosity is given by

$$\xi = \left( \frac{L_5 e^{-\frac{\alpha(n+2)}{3(n-1)}t}}{[-m_1 e^{-\frac{\alpha(n+2)}{3(n-1)}t} + m_2]} + 1 \right) \frac{L_6}{(n+2)L_1} \quad (22)$$

The cosmological term is

$$\Lambda = \left( \frac{\alpha^2 m_1 (n+2)^2}{3K} \right) \cdot \frac{e^{-\frac{\alpha(n+2)}{3(n-1)}t}}{[-m_1 e^{-\frac{\alpha(n+2)}{3(n-1)}t} + m_2]} \quad (23)$$

Expression for average scale factor R and generalized Hubble parameter H are as follows

$$V = R^3 = \left( \frac{K}{n-1} \right)^{\frac{(n-1)(n+2)}{K}} \left[ -m_1 e^{-\frac{\alpha(n+2)}{3(n-1)}t} + m_2 \right]^{\frac{(n-1)(n+2)}{K}} \quad (24)$$

and

$$H = \left( \frac{\alpha^2 m_1 (n+2)}{3K} \right) \cdot \frac{e^{-\frac{\alpha(n+2)}{3(n-1)}t}}{[-m_1 e^{-\frac{\alpha(n+2)}{3(n-1)}t} + m_2]} \quad (25)$$

Expression for expansion factor can be found as

$$\theta = \alpha \left( \frac{\alpha m_1 (n+2)^2}{3K} \right) \cdot \frac{e^{-\frac{\alpha(n+2)}{3(n-1)}t}}{[-m_1 e^{-\frac{\alpha(n+2)}{3(n-1)}t} + m_2]} \quad (26)$$

Expression for shear scalar can be found as

$$\sigma^2 = \alpha \beta \left( \frac{m_1 (n+2)^3}{54K} \right) \cdot \frac{e^{-\frac{2\alpha(n+2)}{3(n-1)}t}}{[-m_1 e^{-\frac{\alpha(n+2)}{3(n-1)}t} + m_2]^2} \quad (27)$$

Expression for mean anisotropic parameter is

$$\Delta = \frac{2(n-1)^2}{(n+2)^2} \quad (28)$$

Where

$$L_1 = \frac{\alpha m_1 (n+2)}{3(n^2 + 3n - 1)}, \quad L_2 = \left( \frac{n^2 + 3n - 1}{n - 1} \right)^{\frac{2(n-1)}{n^2 + 3n - 1}}$$

$$L_3 = \frac{\alpha(n+2)}{3} L_1$$

$$L_4 = \frac{3(2n+1)}{\alpha(n+2)} L_1$$

$$L_5 = \frac{\alpha^2 (n+2)^2 m_1}{3K} \left[ 1 - \frac{(n+1)K^2}{3(n-1)^3} \right]$$

$$L_6 = \frac{K}{3} \left( \frac{n^2}{K^2} + \frac{K(K-n+1)}{(n-1)^3} \right) \left[ 1 - \frac{(n+1)K^2}{3(n-1)^3} \right]^{-1}$$

$$\beta = 4 + \frac{2(n-1)^2}{(n+2)^2}$$

### 6. Conclusion

In this paper we have analysed Kantowski-Sachs String cosmological model with bulk viscosity and varying cosmological term of the form  $\Lambda \propto H$ . For suitable values of constants, it is observed that the cosmological term vanishes as t tends to infinity and infinite at t tends to zero. Hence the cosmological term is a decreasing function of time and it approaches a small positive value at late time.

The scale factors and spatial volume also vanishes as time increases and as t tends to infinity, scale factors and volume become infinite whereas  $\rho, \sigma, \xi$  and  $\Lambda$  tends to zero.

Therefore the model has a point-type singularity at initial epoch. As time increases, the rate of expansion decreases, thus the rate of expansion slows down with increase in time. The model represents shearing, non-rotating and expanding

model of the universe. We also observe that  $\frac{\sigma}{\theta} \neq 0$  therefore model does not approach isotropy. It is clear from expression (28) that mean anisotropic parameter vanishes for n=1.

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