Local boundary value problems for a model equation of the third order of hyperbolic type

Zh.A. Balkizov

Institute of Applied Mathematics and Automation –

branch of Kabardino-Balkarian Scientific Center of the Russian Academy of Sciences

360000, Russia, Nalchik, 89 A Shortanov street

Annotation. Within the framework of this work, three local boundary value problems for a model equation of hyperbolic type of the third order are formulated and investigated. The solutions of the problems posed are written out explicitly. Conditions are found for given functions that ensure the regularity of solutions to the corresponding problems. The obtained representations of solutions to problems will find applications in further formulations and studies of boundary value problems for various equations of mixed and mixed-composite types with a similar model operator in the hyperbolicity domain.

Key words: equations of hyperbolic type of the third order, characteristics of a third order equation, characteristic coordinates, local problem, nonlocal problem, general solution of the problem, regular solution of the problem

REFERENCES

1. Barenblatt G.I., Zheltov Yu.P., Kochina I.N. On the basic ideas of the theory of filtration of homogeneous liquids in fractured rocks. *Applied Mathematics and Mechanics*. 1960. Vol. 25. No. 5. Pp. 852–864. (In Russian)

2. Dzektser Ye.S. Equations of motion of groundwater with a free surface in multilayer media. *Reports of the Academy of Sciences of the USSR*. 1975. Vol. 220. No. 3. Pp. 540–543. (In Russian)

3. Rubinshteyn L.I. To the question of the process of heat propagation in heterogeneous media. *News of the Academy of Sciences of the USSR. Series Geography*. 1948. Vol. 12. No. 1. Pp. 27–45. (In Russian)

4. Ting T., Cooling A. Process according to two temperature theory of heat conduction. *J. Math. Anal. Appl.* 1974. Vol. 45. No. 9. Pp. 23–31.

5. Hallaire M. L'eau et la production vegetable. *Inst. National de la Recherche Agronomique*. 1964. No. 9.

6. Chudnovskiy A.F. *Teplofizika pochv* [Soil thermophysics]. Moscow: Nauka, 1976. 352 p. (In Russian)

7. Kanchukoev V.Z., Shkhanukov M.Kh. Boundary Value Problems for the Modified Moisture Transfer Equation and Grid Methods for Their Solution. *Differential Equations*. 1979. Vol. 15. No. 1. Pp. 68–73. (In Russian)

8. Shkhanukov M.Kh. On some boundary value problems for a third-order equation arising in modeling fluid filtration in porous media. *Differential Equations*. 1982. Vol. 18. No. 4. Pp. 689–699. (In Russian)

9. Shkhanukov M.Kh. On a method for solving boundary value problems for third-order equations. *Reports of the Academy of Sciences of the USSR*. 1982. Vol. 265. No. 6. Pp. 1327–1330. (In Russian)

10. Vodakhova V.A. A Nakhushev's boundary value problem with a nonlocal condition for a pseudoparabolic moisture transfer equation. *Differential Equations*. 1982. Vol. 18. No. 2. Pp. 280–285. (In Russian)

11. Vodakhova V.A. On a Nakhushev's boundary value problem for a third-order equation with a nonlocal condition. *Differential Equations*. 1983. Vol. 19. No. 1. Pp. 163–166. (In Russian)

12. Beshtokov M.Kh. On nonlocal boundary value problems for third-order partial differential equations. *Belgorod State University Scientific Bulletin*. 2013. No. 5(148). No. 30. Pp. 25–47. (In Russian)

13. Beshtokov M.Kh. The Riemann method for solving nonlocal boundary value problems for third-order pseudoparabolic equations. *Bulletin of the Samara State Technical University. Series of Phys.-Math. science*. 2013. No. 4(33). Pp. 15–24. (In Russian)

14. Beshtokov M.Kh. A priori estimates for the solution of nonlocal boundary value problems for a pseudoparabolic equation. *Vladikavkaz Mathematical Journal*. 2013. Vol. 15. No. 3. Pp. 19–36. (In Russian)

15. Makaova R.Kh. The first boundary value problem for the inhomogeneous Aller equation. *Bulletin KRASEC. Physical and Mathematical Sciences*. 2016. No. 4–1(15). Pp. 45–49. (In Russian)

16. Makaova R.Kh. Mixed problem for the inhomogeneous Aller equation. *Adyghe international scientific journal*. 2021. Vol. 21. No. 4. Pp. 18–21. (In Russian)

17. Makaova R.Kh. The first boundary value problem in a non-local setting for the generalized Aller equation with a fractional Riemann-Liouville derivative. *The Bulletin of Adyghe State University: Internet Scientific Journal*. 2017. No. 4(211). Pp. 36–41. (In Russian)

18. Dzhurayev T.D. *Krayevyye zadachi dlya uravneniy smeshannogo i smeshanno-sostavnogo tipov* [Boundary value problems for equations of mixed and mixed composite types]. Tashkent: FAN. 1979. 238 p. (In Russian)

19. Nakhushev A.M. *Uravneniya matematicheskoy biologii* [Equations of mathematical biology]. Moscow: Vysshaya Shkola, 1995. 301 p.

Information about the author

Balkizov Zhiraslan Anatolievich, Candidate of Phys.-Math. Sci., Leading Researcher, Department of Mixed Type Equations, Institute of Applied Mathematics and Automation – branch of Kabardino-Balkarian Scientific Center of the Russian Academy of Sciences;

360000, Russia, Nalchik, 89 A Shortanov street;

Giraslan@yandex.ru, ORCID: https://orcid.org/0000-0001-5329-7766