

## 养殖场原料供不应求条件下沼气反馈供应链波动规律的仿真和微分方程解研究

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Differential equation and simulation solution of methane feedback supply chain fluctuation regular when the demand exceeds the supply of the farm's raw material

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**摘要** 沼气是我国农村重要的生物质能。针对农村户用沼气池缺原料, 但规模养殖的猪粪没有充分开发, 直接排放污染环境的问题, 养殖场、农户、政府、高校四方成立合作社, 在鄱阳湖区实施了以养殖场猪粪为原料促全乡300户用沼气池开发的沼气产业系统工程, 产生了沼气从养殖场至农户的反馈供应链。用系统动力学仿真和微分方程理论方法结合进行反馈供应链的波动规律研究, 首先, 建立沼气产业养殖场至农户反馈供应链三阶基本流程图模型, 又建立其仿真方程, 并应用调控参数法, 建立原料供不应求反馈供应链模型, 同时, 用系统动力学仿真方法求出仿真解。接着, 求对应微分方程解, 进行了仿真解与微分方程解一致性证明。同时, 从仿真解和微分方程解两方面论证了沼气供不应求时反馈供应链的波动规律及其意义。

**关键词:** 沼气 反馈供应链 系统动力学 仿真 微分方程

**Abstract:** The methane is the important biomass energy in China's rural. In the rural area, peasants always lack of material to produce methane, in the other hand, the manure in large-scale breeding farms wasn't developed fully and pollute environment by direct discharge. Farms, households, the government and the university created a cooperative society which created the methane gas industry system engineering to develop 300 households' methane tank using the manure and of farms. This article researched the variation rule of the feedback supply chain with differential equation and the system dynamics simulation. Firstly, We created the three order basic flow graph model of the methane feedback supply chain from farms to households, then founded the feedback supply chain three order constant coefficient differential equation and the system of three order constant coefficient nonhomogeneous equations. Secondly, they created the three order constant coefficient nonhomogeneous differential equation model when demand exceeded supply of manure of the farms with controlling parameters, and solved the special solution and functional solution including sine function, cosine function and exponential function. Thirdly, the simulation solution with the System Dynamics was solved. In addition, they proved the consistency between the simulation solution and function solution. Finally, they presented the fluctuation regular and its significance of methane feedback supply chain when demand exceeded supply.

**Key words:** methane feedback supply chain system dynamics simulation differential equation

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- [1] Forrester J W. System dynamics — The next fifty years[J]. System Dynamics Reviews, 2007, 23: 359-370. 
- [2] 王翠霞, 贾仁安, 邓群钊. 中部农村规模养殖生态系统管理策略的系统动力学仿真分析[J]. 系统工程理论与实践, 2007, 27(12): 158-169. Wang C X, Jia R A, Deng Q Z. A system dynamics simulation analysis on the management policy of rural scale livestock breeding ecosystem in centre China[J]. Systems Engineering — Theory & Practice, 2007, 27(12): 158-169.
- [3] 贾晓菁, 贾仁安, 王翠霞. 自然人造复合系统的开发原理与途径——以区域大中型沼气产业源工程系统开发为例[J]. 系统工程理论与实践, 2010, 30(2): 369-375. Jia X J, Jia R A, Wang C X. Developing theory and approach of the natural and artificial complex system — A case of regional large and medium-sized biogas engineering system development[J]. Systems Engineering — Theory & Practice, 2010, 30(2): 369-375.
- [4] 贾仁安, 涂国平, 邓群钊, 等. "公司+农户"规模经营系统的反馈基模生成集分析[J]. 系统工程理论与实践, 2005, 25(12): 107-117. Jia R A, Tu G P, Deng Q Z, et al. Analysis of the "Company & Farmer" management system by the feedback archetype generating set[J]. Systems Engineering — Theory & Practice, 2005, 25(12): 107-117.
- [5] 同济大学应用数学系. 高等数学[M]. 北京: 高等教育出版社, 2002. Department of Mathematics, Tongji University. Higher Mathematics[M]. Beijing: Higher Education Press, 2002.
- [1] 史建亮, 任戈, 谭毅. 光电跟踪系统集成仿真系统的开发[J]. 系统工程理论实践, 2012, (8): 1864-1870.
- [2] 潘春荣, 伍乃骥, 黄学佳. 基于eM-Plant的参数化虚拟组合设备[J]. 系统工程理论实践, 2012, (8): 1831-1840.
- [3] 李华. 岛屿复合生态系统的动态仿真[J]. 系统工程理论实践, 2012, (8): 1858-1863.
- [4] 宗允露, 熊盛武, 方志祥. 基于蚁群算法的人车混合疏散优化及混合比例分析[J]. 系统工程理论实践, 2012, 32(7): 1610-1617.
- [5] 陈士涛, 杨建军, 赵英俊. 地空导弹武器系统抢修备件配置建模与仿真[J]. 系统工程理论实践, 2012, 32(7): 1618-1622.
- [6] 张戎, 艾彩娟. 基于广义随机Petri网的口岸通关流程建模与仿真——以洋山保税港区进口法检货物的通关流程为例[J]. 系统工程理论实践, 2012, 32(7): 1568-1574.
- [7] 王超, 穆东. 基于SD的制造企业物流运作成本仿真与优化[J]. 系统工程理论实践, 2012, (6): 1241-1250.
- [8] 邓富民, 梁学栋, 刘爱军, 包北方. 多资源约束下改进NSGA-II算法的手术调度[J]. 系统工程理论实践, 2012, (6): 1337-1345.
- [9] 贾伟强, 贾仁安, 兰琳, 张黎明. 消除增长上限制约的管理对策生成法——以银河杜仲区域规模养种生态能源系统发展为例[J]. 系统工程理论实践, 2012, (6): 1278-1289.
- [10] 雷永林, 李小波, 李群, 王维平. 基于SMP2的复杂系统生成式仿真建模方法[J]. 系统工程理论实践, 2012, (5): 1107-1117.
- [11] 许金华, 孙德强, 范英, 任庆娟. 基于FTA仿真的三高气田事故风险概率[J]. 系统工程理论实践, 2012, 32(4): 877-884.
- [12] 钟琪, 戚巍, 张乐. Lotka-Volterra系统下的社会型危机信息扩散模型[J]. 系统工程理论实践, 2012, 32(1): 104-110.
- [13] 刘磊, 许晓鸣. 带Mecanum轮的移动机器人全向移动控制研究[J]. 系统工程理论实践, 2011, 31(专刊1): 66-72.
- [14] 贾仁安, 章先华, 徐兵, 段志诚, 涂国平, 张南生. 低碳生态能源经济循环农业系统工程典型模式及配套技术[J]. 系统工程理论实践, 2011, 31(专刊1): 124-132.
- [15] 贾仁安, 刘静华, 邓群钊, 涂国平, 张南生. 反馈系统发展规划的对策实施效应仿真评价[J]. 系统工程理论实践, 2011, 31(9): 1726-1735.