determined via Taguchi Signal to Noise Ratio are pressure of 0.089 MPa and number of microneedles is 49 i.e., 7x7 microneedle square array. These conditions will provide an efficient drug delivery through square microneedle array of a MEMS based drug delivery system. The performance optimization of MEMS based microfluidic drug delivery system can be extended to a variety of microneedle designs, microneedle array designs and different types of micropumps in future.

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REFERENCES

1. Apichart Boonma 2012, 'Geometric Modeling and Analysis of Microneedle Interaction with Soft Tissue for Biomedical Applications', PhD Thesis.
2. Nisar, Nitin Afzulpurkar, Banchong Mahaisavariya & Adisorn Tuantranont 2008, 'MEMS-based micropumps in drug delivery and biomedical applications', Sensors and Actuators B, vol. 130, pp. 917–942.
3. Hiroaki Suzuki, Rei Yoneyama 2002, 'A reversible electrochemical nanosyringe pump and some considerations to realize low-power consumption', Sensors and Actuators B, vol. 86, pp 242–250.
4. Chailaos Mousoulis, Manuel Ochoa, Demetrios Papageorgiou & Babak Ziaie 2011, 'A Skin-Contact-Actuated Micropump for Transdermal Drug Delivery', IEEE Transactions on Biomedical Engineering, vol. 58, no. 5, pp. 1492-1498.
5. Muhammad Waseem Ashraf, Shahzadi Tayyaba, Nitin Afzulpurkar, Asim Nisar, Adisorn Tuantranont & Erik LJ Bohez 2010, 'Coupled Multifield Analysis of Piezoelectrically Actuated Microfluidic Device for Transdermal Drug Delivery Applications', World Academy of Science, Engineering and Technology, vol.4, no.2, pp. 02-23.
6. Raja Rajeswari N & Malliga P , " Microfluidic system using microneedles for Targeted Drug Delivery in Cancer Therapy" in International Conference on Smart Structures & Systems(ICSSS-2013) ,March28-29,2013,Chennai,India, Pg 53-59 IEEE Xplore.
7. Raja Rajeswari N & Malliga P, "Insertion of Microneedle Array into Soft Tissue for Transdermal Drug Delivery", Ciencia e Tecnica Vitivinicola, A Science and Technology ISI Indexed Journal, ISSN: 0254-0223, 29(10) (2014).
8. Raja Rajeswari N & Malliga P, "Design of MEMS Based Microneedle for Drug Delivery System", Procedia Engineering, Elseveir, 97 (2014), 2001-2010.
9. Raja Rajeswari N & Malliga P, "Analytical approach for optimization design of MEMS based microneedles in drug delivery system", Journal of Mechanical Science and Technology, 29 (8) (2015) 3405-3415, Springer.

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