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**Review Article**

# Environmental Water pollution: A Review of Physicochemical and Heavy metal Quality of Water and Soil

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***ABSTRACT***

***Water resource shortage and pollution has seriously threatened the survival and development of developing countries. Because of India's specific economical and social circumstances, complete adoption of developed countries experience is unrealistic. At present, India needs to develop strategies and technologies in source water pollution control and industrial and municipal environmental remediation that embrace the country's specific need to battle the water resource problem. This paper reviewed ecosystem pollution with particular reference to heavy metal in water and soil system endangered by mixed effluents of domestic as well as industries.***

**Keywords:** water pollution, heavy metal, soil ecosystem, pollution review

## INTRODUCTION

Water is the resource that sustains all life on earth and is a key element of sustainable development. It is essential if human beings are to enjoy healthy and safe lives or realize social and economic development. Ecosystems are also inextricably linked with water.

Historically, water had been regarded as an infinite resource. However, humans are dependent on a mere fraction of one percent of the earth's freshwater—that found in lakes, rivers, and groundwater aquifers—as that water is the only freshwater which is readily accessible. As population growth and economic expansion accelerated and intensified the use and abuse of water resources over the past few decades, a greater and greater imbalance between water availability and water demand has resulted. This imbalance has brought a veritable crisis with regard to water in many regions of the world, including but not limited

to such problems as widespread water scarcity, water quality deterioration, and the destruction of freshwater resources.

It is projected that by 2025, about 3.5 billion people—approximately 6.5 times as many people as in the year 2000—will live in water-stressed countries. There are at least 1.1 billion people without access to a safe water supply and about 2.5 billion without adequate sanitation systems and the majority of them live in developing countries.

Water scarcity impacts food availability, human health, livelihoods and also economic development. It is said that the poor are the most vulnerable to the impact of this water crisis. For a region which is home to about 60 percent of world's population and about 70 percent of the world's poor, the conservation of and environmentally-sound use of freshwater resources is the crucial element for socio-economic development and poverty alleviation.

This paper provides an overview of freshwater issues in India as a key issue for sustainable development in the region.

## REVIEW OF LITERATURE

The review of literature is relevant to the objective of the study, i.e., status of water quality as well as information on the development of cost effective suitable method in the removal of pollutants from water. A brief review of the different aquatic pollution and to remove the pollutants has also been included. A few numbers of discussions on the current thinking about the water quality for rural people has also been incorporated. The most common and wide spread threat associated with water is contamination, either directly or indirectly, by sewage, by other wastes or by human or animal excrement. If such contamination is recent, and if among the contributors, there are carriers of communicable enteric diseases, some of the living casual agents may be present. The drinking water so contaminated or its use in the preparation of certain foods may result in further cases of infection.

***Ground Water Issue:*** Jain et al. (2010) found that groundwater quality at most of the locations of Nainital District is not upto the mark due to the quartzite rocks in the region.

Abdul Jameel and Sirajudeen (2006) identified that most of zones in and around Pettavaithalai area, Tiruchirappalli, Tamil Nadu-India is polluted due to the sugar mill effluent seepage into the groundwater table. All the test results confirm that the ground water quality is not upto the mark and is slowly degrading.

Aggarwal Shankar et al. (2001) identified the rain and fog water samples collected from Bikunthpur and Korba sites were found to be acidic in nature (i.e. pH<5). However, samples from Ambikapur, Bilaspur, Raipur and Bhilai were slightly acidic and their pH values were always around 5.8. Concentrations of Al, Hg, Mn, Cd and Pb were higher in fish from acid, than from less acid waters.

Agrwal Madhoolika et al. (2001) quantified the atmospheric deposition and wet depositions at different sites in Singrauli area of Sonbhadra district, U.P., India. The monthly variation in rain water pH clearly indicate that early rainfall is more alkaline and as rainy season proceeds rainwater showed lower pH.

***Heavy metal issues:*** Abraham Beena et al. (2002) identified that pollution of the natural environment from a wide range of sources and pollutants become an inevital feature of the present day living and look out for the distribution of toxic metals, mercury and lead and also different hydrographic parameters in the River Periyar. Efforts have also been taken to study the effects of different electrolytes and salinity on the adsorption, desorption and retention of Hg (II) ions.

Abraham Beena et al. (2002) identified the presence of chromium in industrial effluent and attempted to treat with a suitable method.

Islam et al. (2009) studied heavy metal (Pb, Cd, Zn, Cu, Cr, Fe and Mn) content in Textile sludge in Gazipur, Bangladesh found out all heavy metals concentration except chromium in the sludge samples were higher than that of in agricultural soil.

***Impact by industrial effluents:*** Balakrishnan et al. (2008) studied the impact of dyeing industrial effluents on the groundwater quality in Kancheepuram (India) marked as red colour industry. Most of the samples exceed the limits of BIS and WHO.

Balasubramanian (2006) studied the reuse of textile effluent treatment plant sludge in building materials and found that ETP sludge up to 30% substitution for cement may be possible in the manufacture of non-structural building materials and serve as an alternative solution to disposal.

Hasan and Agarwal (2004) reviewed the recycle and reuse of wastewater has become a need of time due to limited water resource. A large number of effluents, domestic sewage and industrial wastewater can be reused to a significant extent after suitable treatment. Several steps have been taken by India in the direction of pollution control. The efforts have eventually resulted in the reuse of discharged treated effluents either in the same industry or for some other purposes.

***River / Surface water issues:*** Abdul Jameel and Zahir Hussain (2011) identified that most of the groundwater sampling stations near the Uyyankondan channel, Tiruchirappalli are much polluted by the intrusion of channel water, dumping of waste and percolation of domestic sewage by inhabitants.

Animesh Agarwal and Manish Saxena (2011) carried out study at river Gagan with regression analysis which is not only time saving but also cost effective.

The **Table 1** shows the list of more numbers of recent studies made on surface water, ground water, soil for general physicochemical and heavy metal analysis. The findings from their studies also explained in the table.

**Table 1:** list of more numbers of recent studies on surface water, ground water, soil for general physicochemical and heavy metal analysis

| Sl. No. | Author Name | Title | Year | Findings |
|---|---|---|---|---|
| 1. | Rizwan Reza and Gurdeep Singh | Physico-chemical analysis of Ground Water in Angul-Talcher Region of Orissa, India | 2009 | Pre-monsoon season was better than post monsoon season. High TDS and alkaline noticed. |
| 2. | Abdul Jameel A. and J. Sirajudeen | Risk Assessment of physico-chemical contaminants in ground water of pettavaithalai area, tiruchirappalli, Tamil Nadu-India | 2006 | Parameters such as pH, EC, TDS, TH, NO3, SO4, PO4, Na, K, Ca, Mg, DO, BOD and COD were very high around the industrial area. |
| 3. | Animesh Agarwal and Manish Saxena | Assessment of pollution by physicochemical water parameters using Regression analysis: A case study of Gagan river at Moradabad-India | 2011 | Study gives a tool to find the extent of pollution theoretically and also shows high pollution by industrial as well as domestic activities. |
| 4. | Garg, R.K., R.J. Rao, D. Uchchariya, G. Shukla and D.N. Saksena | Seasonal variations in water quality and major threats to Ramsager reservoir, India | 2010 | Reservoir is under the category of mesotraphic water body slightly inclined towards eutrophication because of pollution by industries. (2003-05) |
| 5. | Shivaraju | Impact Assessment of sewage discharge on | 2011 | Groundwater samples around sewage treatment are high contaminated and |

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| | | underground water qualities around municipal sewage treatment plant (Mysore city, India) | | unfit for the drinking purposes. |
| 6. | Singh Jiwan and Kalamdhad Ajay S. | Effects of heavy metals on soil, plants, human health and aquatic life | 2011 | Heavy metal containing compost may change the physical, chemical and biological properties of soil and water and ultimately affect plant and human health. |
| 7. | Reza R. and G. singh | Heavy metal contamination and its indexing approach for river water | 2010 | Angul river is highly polluted by heavy metal due to various mines along the river course. |
| 8. | Vaishnav M.M. and S. Dewangan | Analytical study of physico-chemical and metallic elements of groundwater and surfacewater in Balco industrial area, Korba, C.G. | 2011 | Water sources in and around Balco industries are not applicable for any purpose in human development |
| 9. | Anu, S.K. Upadhyaya and Bajpai Avinash | Heavy metal analysis of various water bodes located in and around Bhopal, M.P.-India | 2011 | Pollution of Water bodies at Bhopal is in alarming level. |
| 10. | Papafilippaki, A.K., M.E. Kotti and G.G. Stavroulakis | Seasonal Variations in Dissolved heavy metals in the Keritis River, Chania, Greece | 2008 | Seasonal variation of Cu, Zn, Cd, Pb and Cr in the Keritis river, significant variations were found between warm and wet period. Order is Zn>Pb>Cu>Cd >Cr. The electrical conductivity seams to have no correlation with the seasonal variations of dissolved metals. Significant relationships where observed between the heavy metals concentration and the water pH in both periods. |
| 11. | Swapnil Rai, et al. | Comparative study of some physicochemical parameters of soil irrigated with sewage water and canal water of Dehradun city, India | 2011 | Area high polluted with heavy metal in soil and water. |
| 12. | Ch. Subba rao, B. Sreenivasa Rao and A.V.L.N.S.H. Hariharan | Analysis of heavy metals in groundwater from Guntur Dt. (AP) | 2010 | Most of the samples having heavy metals and unfit for drinking. |
| 13. | Mahananda, M.R., B.P. Mohanty & N.R. Behera | Physico-chemical analysis of surface and groundwater of bargarh district, Orissa, India | 2010 | Groundwater satisfy for the use of various purposes like domestic, agricultural, industrial etc., But surface water, the water quality of small community pond are above the permissible limit. |
| 14. | Sairy Abdullah, Mohammed Asaf Iqbai, Mohammed | Physico-Chemical analysis of the freshwater at Kundalika Dam, Upli, | 2010 | Most of the stations around Dam, water parameters above the permissible limit. |

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| | Ilyas Fazil | Dist. Beed, (M.S.) India | | |
| 15. | Patil V.T. and P.R. Patil | Physico-chemical analysis of selected groundwater samples of Amalner town in Jalgaon district, Maharashtra, India | 2010 | Very few stations nearby to sewage pond shows above the permissible limit. Showed increase in trend with respect to higher year. |
| 16. | Anurag Tewari, Ashutosh Dubey and Aviral Trivedi | A study on physico-chemical characteristics of groundwater quality | 2010 | Studied area is polluted heavily as per GIS information. Periodic monitoring is required. |
| 17. | Nagajyoti, P.C., T.N.V.K.V. Prasad, N. Dinakar, S. Suresh and T. Damodharan | Impact of Dyeing unit effluent on nutrient content of Index Leaf of Arachis hypogaea L. and Sacharum officinarum L. | 2010 | Accumulation of considerable amounts of soluble salts was observed in the immediate vicinity of the effluent stream as compared the distances far away from the effluent stream. Application of effluent to agricultural fields reduces the quantity of water required for irrigation and helps in water conservation and provides nutrients to the fields and plants |
| 18. | Gupta, D.P., Sunita and J.P. Saharan | Physicochemical analysis of groundwater of selected area of Kaithal city(Haryana) India | 2009 | It is found that some of the water samples are non-potable for human being due to high concentration of one or the other parameter. |
| 19. | Srinivasamoorthy K. et al., | Hydrogeochemical characterization of groundwater in salem district of Tamil Nadu, India | 2009 | The abundance of major ions in the groundwater is in the order of Na > Ca>Mg >K=Cl>HCO3>SO4>NO3. NO3, Cl, SO4 and F exceed the permissible limit during both the seasons. |
| 20. | Khodapanah, L. W.N.A. Sulaiman and N. Khodapanah | Groundwater quality assessment for different purposes in Eshtehard District, Tehran, Iran | 2009 | It is observed that the quality of groundwater is not suitable for drinking and domestic purpose in most water samples according to the EC and SAR calculation |
| 21. | Prasanna M.V. et al., | Hydrogeochemical assessment of groundwater in Neyveli basin, cuddalore district, south India | 2010 | Rock weathering and ion exchange reactions are the major hydrogeochemical processes responsible for the concentration of major ions in groundwater. Higher concentration of nitrate in some groundwater can be resulted from the agricultural activities. |
| 22. | Madhu Rani Sinha et al., | Physicochemical examination and quality assessment of groundwater (Hand pump) around Patna main town, Bihar, India | 2011 | shows deviations from water quality standards indicating groundwater contamination at Patna city zone, water from this sites is unfit for drinking purpose |
| 23. | Islam M.M. et al., | Heavy metal (Pb, Cd, Zn, Cu, Cr, Fe and Mn) content in Textile sludge in Gazipur, Bangladesh | 2009 | All heavy metals concentration except chromium in the sludge samples was higher than that of in agricultural soil. |
| 24. | Usha Rani et al., | Physico-chemical and bacteriological characteristics of noyyal | 2010 | The rise of the inflow of waste is clearly due to the rapid growth of residential and commercial activities |

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| | | river and ground water quality of perur, India | | in the study area. Due to the discharge of sewage, domestic wastes and human activities the phosphate, BOD and CODload in river water exceeds the permissible limit of WHO drinking water standards. |
| 25. | Aggarwal, TR, Singh, KN, Gupta, AK | Impact of sewage containing domestic wastes and heavy metals on the chemistry of Varuna River. | 2000 | |
| 26. | Vijaya bhaskar, C., Kiran kumar and G. Nagendrappa | Assessment of heavy metals in water samples of certain locations situated around Tumkur, Karnataka, India | 2010 | Cu, Fe, Ni and Zn were detected in all the samples and found in the range of 0.094-0.131, 0.958-12.537, 0.020-0.036 and 0.082-1.139 mg/L respectively in surface waters and these are in the range of 0.132-0.142, 0.125-1.014, 0.028-0.036 and 0.003-0.037 mg/L in ground- waters. The elements cadmium, mercury and manganese are absent in all the samples. |
| 27. | Balasubramanian | Reuse of textile effluent treatment plant sludge in building materials | 2006 | Use of Textile ETP sludge up to a maximum of 30% substitution for cement may be possible in the manufacture of non-structural building materials. The use of Textile ETP sludge in these applications could serve as an alternative solution to disposal. |
| 28. | Kamala Kanta Borah, Bhabajit Bhuyan and Hari Prasad sarma | Lead, Arsenic, fluoride and iron contamination of drinking water in the tea garden belt of Darrang district, Assam, India | 2010 | study revealed that the water sources in the area are heavily polluted with lead. |
| 29. | Ranjana Agrawal | Physico-chemical analysis of some groundwater samples of Kotputli town, Jaipur, Rajasthan | 2010 | Comparative studies of samples in different seasons were conducted. It was found that there is no appreciable change in the different parameters during rainy season. It was also analyzed that Electrical Conductivity and Total Dissolved Solids (TDS) were decreased in the rainy season, and Alkalinity, Total Hardness were increased after the rainfall. |
| 30. | Hema Patel and Suneel Pandey | Exploring the reuse potential of chemical sludge from textile wastewater treatment plants in India-A hazardous waste | 2009 | The concentrations of heavy metals were negligible in the TCLP leachate and thus below USEPA regulatory limits. |
| 31. | Prakash K.L. and R.K. Somashekar | Groundwater quality – Assessment on Anekal Taluk, Bangalore Urban district, India | 2006 | Of these samples 81.48% of water samples were found beyond the acceptable limit of BIS. In the above mentioned 836 samples at least one of the parameters is more than the |

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| | | | | acceptable limit of BIS. From the present study it is evident that groundwater quality is gradually getting deteriorated and it may deteriorate further with time. |
| 32. | Sachin M. Kanawade and R.W. Gaikwad | Removal of Zinc ions from industrial effluent by using cork powder as adsorbent | 2011 | Rmoval of zinc from electroplating industrial wastewater using a cheap adsorbent, cork powder. 98% of zinc removal was found in synthetic wastewater whereas the removal percentage for the electroplating industrial wastewater was observed to be 91%. |
| 33. | Nasim Ahmad Khan, Shaliza Ibrahim and Piarapakaran Subramaniam | Elimination of Heavy metals from wastewater using agricultural wastes as adsorbents | 2004 | The sorption capacity is dependent on the type of the adsorbent investigated and the nature of the wastewater treated. The use of commercially available activated carbon for the removal of the heavy metals can be replaced by the utilization of inexpensive, effective, and readily available agricultural by-products as adsorbents. |
| 34. | Meena K.S. et al., | Nitrate contaminations in groundwater of villages of Deoli Teshil, Rajasthan | 2011 | High nitrate concentration makes the ground water unsuitable for drinking purpose. Permissible limit of nitrate is 40-50 mg/L by WHO. High nitrate levels in water can cause methemoglobinemia or blue baby syndrome, this condition is found especially in infants under six months age. |
| 35. | Nese Tufelcci et. Al., | Pollutants of Textile industry wastewater and assessment of its discharge limits by water quality standards | 2007 | biological oxygen demand (BOD) and chemical oxygen demand (COD) are relatively high in slashing, fabric formation, and wet processing and therefore, are more important pollution prevention targets. |
| 36. | Sapci et al. | The removal of color and COD from textile wastewater by using waste pumice | 2003 | Adsorption of pumice is very low related to color or COD removal, where there was an obvious raise due to FeSO4 addition. Consequently, the best COD and color removal efficiencies are obtained by an increase on the ratios of pumice, FeSO4 and Ca(OH)2. |
| 37. | Murhekar Gopalkrishna H. | Determination of physico-chemical parameters of surface water samples in and around Akot city | 2011 | All sampling sites showed physico chemical parameters above the water quality standards and the quality of water are very bad and it is unfit for drinking purpose. |
| 38. | Rajamanickam R. and S. Nagan | Groundwater quality modeling of amaravathi river basin of karur district, tamil nadu using | 2010 | The textile bleaching and dyeing units and CETPs shall provide zero liquid discharge plant as recommended by the TNPCB. The discharge into the |

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| | | visual mudflow | | river system should be completely stopped. The domestic sewage from the Karur town should be completely collected, treated and used for farming. |
| 39. | Gopalakrishnan K. and T. Jeyadoss | Comparative study on biosorption of Zn(II), Cu(II) and Cr(VI) from textile dye effluent using activated rice husk and activated coconut fibre | 2011 | Activated coconut fibre shows better adsorption capacity than Activated rice husk. |
| 40. | Abida Begum and Harikrishna | Study on the quality of water in some streams of cauvery river | 2008 | Brewery effluent discharged directly into stream causes severe water chemistry modification. |
| 41. | Jafar Ahamed A. and K. Riaz Ahamed | Preparation and characterization of activated carbon from the Prosopis juliflora plant | 2008 | Good adsorbent for the removal of both organic and inorganic impurities. |
| 42. | Balakrishnan, M., S. Arul Antony, S. Gunasekaran and R.K. Natarajan | Impact of dyeing industrial effluents on the groundwater quality in Kancheepuram (India) | 2008 | Marked as red colour industry. Most of the samples exceeds the limits of BIS and WHO. |
| 43. | Dhanya, D., S. Tamilarasi, R. Subashkumar and P. Lakshmanaperumal samy | Impact of dyeing industrial effluent on the groundwater quality and soil micro-organisms in Tirupur. | 2005 | Soil texture and micro organisms got polluted by high TDS and heavy metals. |
| 44. | Gowrishankarm, R., R. Palaniappan and S. Sankar | Bacteriological evaluation of rural drinking water systems | 1998 | Rural drinking water is contaminated with bacteriological matter due to municipal sewage. |
| 45. | Imada K and Hashizume S | Fibre reactive dyes for cotton: reducing the level of colour in wastewater effluent | 1993 | Colour causing chemicals are main pollutant in aquatic samples. |
| 46. | Kannan N and Thavamani K | Assessment of industrial groundwater pollution potential from correlation of parametric ratios-Dye industry | 1993 | Groundwater is heavily polluted by dyeing industries effluent and statistically proved. |
| 47. | Kesavan K.G. and Parameswari R | Evaluation of groundwater quality in Kancheepuram | 2005 | Textile effluent is the main cause of pollution. |
| 48. | Singh A.K. | Chemistry of arsenic in groundwater of Ganges-Brahmaputra river basin | 2006 | Late 70's, not found any trace metals. Recently it is in increasing trend due to industrialization. |
| 49. | Sacchidananda Mukherjee and Prakash Nelliyat | Groundwater pollution and emerging environmental challenges of industrial effluent irrigation in mettupalayam taluk, Tamil Nadu | 2007 | Continuous disposal of industrial effluents on land, which has limited capacity to assimilate the pollution load, has led to groundwater pollution. |
| 50. | Abida Begum and Harikrishna | Study on the quality of water in some streams of cauvery river | 2008 | Because of sugar and brewery distilleries showed water chemistry is not fit for domestic applications. |
| 51. | Palanisamy P.N. and Kavitha S.K. | An assessment of the quality of groundwater in | 2010 | Study area confirms the deterioration of groundwater quality and calls for |

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| | | a textile dyeing industrial area in Erode city, Tamil Nadu, India | | some effective measures to be taken urgently. |
| 52. | Raja G. and Venkatesan P. | Assessment of groundwater pollution and its impact in and around Punnam area of Karur District, Tamil Nadu, India | 2010 | Areas groundwater is in alarming level of pollution due to neighbouring textile industries. |
| 53. | Sivakumar K.K. et al. | Assessment studies on wastewater pollution by textile dyeing and bleaching industries at Karur, Tamil Nadu | 2011 | The high values obtained for the parameters assessed, especially those of the concentrations of the solid and of the oxygen demands, call for a pretreatment of the effluent before its discharge into water body. |
| 54. | Sivakumar K.K. et al. | Studies on physico chemical analysis of ground water in Amaravathi river basin at karur(Tamil Nadu), India | 2011 | Drinking water quality of monsoon was better than premonsoon or summer. This is due to the under depth of water table. |
| 55. | Sivakumar K.K. and M.S. Dheena dayalan | PJC and CAC in the removal of COD from aqueous solution | 2011 | As alternative to commercial Activated Carbon Prosopis Juliflora Carbon (PJC) blend has shown quite effective adsorbent capacity for COD removal from the domestic wastewater. Though its capacity is lower than that of commercial grade activated carbon, the low cost material makes it an attractive option for the treatment of domestic wastewater. |
| 56. | Sivakumar K.K. and M.S. Dheena dayalan | Assessment study of impact on Santhanavarthini river due to effluent discharge by the textile industries and tannery in Dindigul, Tamil Nadu | 2010 | Found that surrounding industries causes considerable increase in the heavy metal and TDS. |
| 57. | Kristina Furn | Effects of dyeing and bleaching industries on the area around the Orathupalayam Dam in Southern India | 2004 | i)Explained the serious problem<br>ii) Explained Action needed for the affected people<br>iii) Explained suggestions to the industries<br>iv) Explained suggestions to the pollution control board and PWD |

## CONCLUSION

From the above findings and information obtained from table, the following ideas are suggested to improve the water resources

- Promote a national focus on water sector reform
- Improve and expand the delivery of water services, mainly water supply and sanitation (urban and rural), irrigation and drainage
- Foster the conservation of water and increase system efficiencies

- Promote regional cooperation and increase the mutually beneficial use of shared water resources within and between countries
- Facilitate stakeholder participation through the exchange of water sector information and experience
- Improve governance
- Water quantity and quality assessment
- Comprehensive assessment of water resources in a river basin context
- Socio-economic assessment; role of water in sustainable development
- Valuing water
- Reforming water-related institutions
- Promotion of effective and efficient implementation of water pollution control laws and regulations
- Introduction of less water-consuming agricultural technologies and methods
- Preparation of safety nets for calamity damage
- Contrivance of policy packages
- Supporting actions such as raising of public awareness and enhancement of participation of all stakeholders in decision making processes
- Promotion of capacity building in policy implementation
- Promotion of International/Regional cooperation Encouragement of technology transfer
- International river basin management
- In addition, expansion of urban areas accelerates the conversion of forest and agricultural land and would result in changes in the hydrological cycle. The key is how to mobilize people to take action and how to value water for equitable use for people and the environment.

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