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# Curriculum of Sanitary Engineering in Universities of India: Vis-À-Vis Requirements of Modern India

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**Abstract** In-sanitation is the prime cause of diseases in India. In India public health and environmental cost due to unsafe sanitation consumes 60% of its gross domestic production. The problem has got roots in the socio-economy, culture and even administration. The government of India launched several comprehensive cleanliness programs. They are aimed to provide sanitation facilities to every countryman. Nevertheless the statistics shows that the successes of the programs are low. The successful implementation of the sanitation program requires technological input. This input is given by sanitary engineers. The curriculum of sanitary engineering must be designed to prepare engineers to tackle the specific indigenous sanitation problems. To analyze whether the curricula of Indian universities meet this requirement, the curricula of sanitary engineering of various esteemed Indian universities/institutions have been examined here. It is found that the curriculums do not meet the specific technological requirements of the country. They include the technology which is suitable for the developed countries but it is unable to train the engineers to meet the specific indigenous requirement. Here, suggestions are given to suitably modify the curriculums as per the native requirements. The present study especially refers to India, yet has due relevance to the all third world countries.

**Keywords** Sanitation, Engineering, University Curriculum

## 1. Introduction

Modern humans (Homo sapiens) have dwelled on this earth for some 200 000 years. The earliest known permanent settlement, which can be classified as urban, is Jericho from 8000–7000 B. C.. Harappa Civilization, 2800 B. C., had world's earliest known system of flush toilets. These existed in many homes, and were connected to a common sewerage pipe. The first evidence of the purposeful construction of the water supply, bathrooms, toilets and drainage in Europe comes from Bronze Age Minoan Crete in the second millennium B.C. [1].

However the sanitation scenario in modern India is not bright. In modern India over 85% diseases can be directly linked to the insanitation. Figure 1 shows health impact of poor sanitation [2].

Few sensitizing facts about sanitation problem in India are highlighted in figure 2.

Obviously sanitation is a grave concern in modern India. Government of India had recognized the importance of sanitation long ago. It initiated sanitation program named 'Central rural sanitation program' in 1986. It was restructured as 'Total sanitation campaign' in 1999, and 'Nirmal Bharat abhiyan' in 2012. Every time it aimed to provide pure water and sanitation to every countryman. Recently the Prime Minister of India has ambitiously reformed and re-launched 'Swacch Bharat Abhiyan (Clean India Movement)' with effect from October 2$^{ND}$ 2014 [3]. However, the success of all theses campaigns is low.

The Baseline survey report by Ministry of Drinking water and sanitation shows that only 54.28% households in rural India have toilets and 87% of them are functional. Table 1 summarizes these facts.

**Table 1.** Sanitation coverage in India

| | |
|---|---|
| National drinking water coverage | 82.4% |
| National sanitation coverage | 46.9% |
| Open defecation, national average | 49.2% |
| Rural sanitation coverage | 30.7% |
| Urban sanitation coverage | 81.4% |

The under success of these ambitiously launched campaigns may be attributed to the lack of amalgamation of technology with their administration.

Urban sector sanitation largely depends upon septic tanks. Over 38% of urban population is deprived of sewerage network [4]. The survey report further states that out of 1.2 billion, 0.6 billions do not have toilet at home. Under these circumstances, India needs comprehensive strategies to

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enhance its sanitation facilities. These strategies must be technologically sound and socio-economically consistent.

The problem of sanitary engineering is simple in developed nations. There almost 100% population has water carriage system of human excreta, and sewerage network. There sanitary engineering means: to collect sewage, transport it through sewerage network, treat it in wastewater treatment plants, and finally either discharge the treated sewage to natural receiving bodies or to reuse it. However in Indian context the problem is different. Here open defecation is a major problem. A larger fraction of the population does not have water carriage system and sewerage system. There are many people who cannot afford toilets. There are people who do not want toilets due to socio-cultural reasons, ignorance and illiteracy [2]. Municipalities and such statutory bodies are deficient in funds to provide 100% sewerage network and sewage treatment facilities. In fact in Indian context, sanitary engineering means 'low cost toilets'. As majority of the Indian population has inadequate supply of water, it needs toilets which can work with minimum water. Researchers have developed several low cost eco-toilets that use minimum water. These toilets dispose-off sewage on site [5]. It requires that the Indian sanitary engineers must be well trained to tackle the indigenous sanitation requirements. They must be trained to design low cost toilets and eco-toilets.

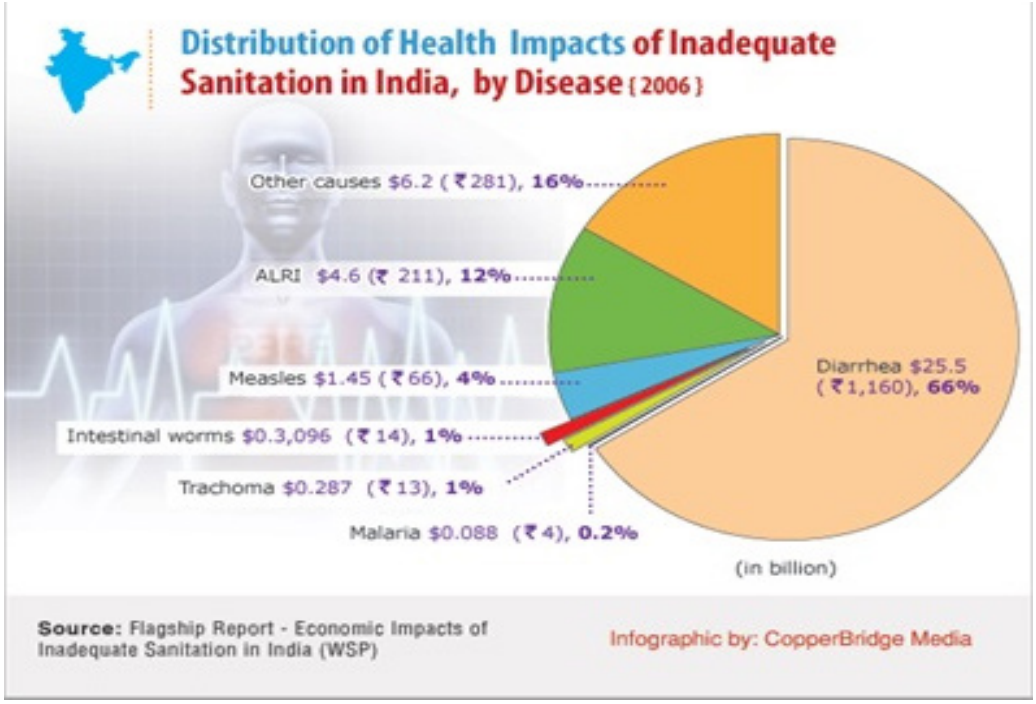


**Figure 1.** Health impact of insanitation in India


**Figure 2.** Impacts of insanitation in India

In the present work, the curriculums of some reputed Universities and Engineering Institutes of India have been examined vis-à-vis this requirement. It is found that the curriculums are not designed to take care of this indigenous requirement. The curriculums basically include advanced wastewater engineering technology, e.g. collection of sewage, its transportation through sewerage and its treatment. This is in conformity to the requirement of developed countries of the world.

Here, suggestions are given to suitably amend the curriculums of sanitary engineering of Indian universities to suit to the native requirements.

## 2. Curriculum of Sanitary Engineering

Sanitary engineering is included in the curriculum of civil engineering under graduate course which is a four year course in most of the universities in India. There are two courses of sanitary engineering in the civil engineering curriculum. These courses are respectively water supply engineering, and wastewater engineering. Generally these courses are at third year and final year level respectively. These courses are also named as public health engineering (I & II) or environmental engineering (I & II) etc. The topics of sewage collection and treatment are included in the curriculum of wastewater engineering. Here, the curriculum of wastewater engineering of some major universities has been analyzed. The analysis is done with reference to the relative weight given to the topics of advanced wastewater engineering, and low cost sanitary engineering. Amongst low cost sanitary engineering technology, septic tank is also important. In rural as well as urban areas, where water carriage system is used but the sewerage network is not available, septic tank is the most commonly used technology. Hence it is also an important technology in Indian context.

The observations of curriculum analysis are summarized in table 2. The curriculum of sanitary engineering contains some general topics like characterization of sewage and its pollution effects etc. It also includes wastewater collection, removal and treatment technology. In the present analysis, the onsite disposal technology like dry privy or eco-toilet etc is considered as low cost sanitary technology. Sewerage network design and treatment by advanced methods activated sludge, trickling filter etc is considered as advanced sanitary engineering. The relative weight given by various institutes to low cost technology and advanced technology is determined.

**Table 2.** Analysis of wastewater engineering curriculum

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Anna Technical University, Tamil Nadu www.annauniv.edu | EE II | 77% | 1.5% | 1.5% | AAAA+ |
| College of Engineering Trivendrum, Kerala www.cet.ac.in | EE II | 60% | Nil | 7% | AAAA |
| BMS college of engineering, Banglore, Karnataka www.bmsce.in | EE II | 60% | Nil | 5% | AAAA |
| AU College of Engineering, Vishakhapattanam, Andhra http://andhrauniversity.edu.in | EE II | 75% | Nil | 7% | AAAA |
| College of engineering Pune, Maharashtra www.coep.org.in | WWE | 70% | 0% | 10% | AAAA+ |
| Guru Gobind Singh Indraprashta University, Delhi www.ipu.ac.in | WWE | 75% | 0% | 5% | AAAA |
| Bhagalpur College of Engineering, Bihar www.bcebhagalpur.ac.in | 1. EE<br>2. AEE | 60%<br>70% | 10%<br>0% | 10%<br>15% | AAA+ |
| Silicon Institute of Technology, Orissa www.silicon.ac.in | WS & SE | 80% | 0% | 0% | AAAA |
| College of engineering Pune, Maharashtra www.coep.org.in | WWE | 70% | 0% | 10% | AAAA+ |
| Guru Gobind Singh Indraprashta University, Delhi www.ipu.ac.in | WWE | 75% | 0% | 5% | AAAA |
| Bhagalpur College of Engineering, Bihar www.bcebhagalpur.ac.in | 1. EE<br>2. AEE | 60%<br>70% | 10%<br>0% | 10%<br>15% | AAA+ |
| Silicon Institute of Technology, Orissa www.silicon.ac.in | WS & SE | 80% | 0% | 0% | AAAA |

Where,
1→ name of university
2→ name of the subject
3→ % weight given to the advanced sanitary engineering technology
4→ % weight given to the low cost sanitary engineering technology
5→ % weight given to the septic tank technology
6→ Rank

## 3. Sampling Methodology

The selection of universities and engineering institutions is done based upon the following criteria: Sharma and Chandra [6] have done a survey of technical institute of India. They have ranked the institutes in following categories- AAAAA (Exceptional), AAAA+ (Outstanding), AAAA (Very good), AAA+ (good), AAA (Above average), AA+ (Fair), AA (Average), A+ (Pass), A (Improve). They have considered quality of students, research output, industry interface, refereed publications and academic productivity. Out of this, institutes of rank AAAAA, AAAA+, AAAA, and AAA+ are sampled. Care is taken that the universities and colleges are uniformly distributed across the geography of the country.

In table 2, EE II, WWE, WS & SE and AEE respectively mean Environmental engineering II< Wastewater engineering, Water supply and sanitary engineering, and Advanced environmental engineering.

In addition to the above mentioned universities, the curriculums of esteemed engineering organizations like IITs and NITs have also been referred. However they have not been included in the table, because their curriculums available on websites are too concise and their delivery largely depends upon the teacher concerned.

## 4. Conclusions

It is clear from the observations of table 2 that the curriculums of sanitary engineering of Indian universities/ engineering institutes have given most of the emphasis on water carriage systems, sewerage network and advanced wastewater treatment systems. The emphasis given to septic tanks and low cost excreta disposal technology is very less. Whilst, they are the actual need of the country. The sanitary engineers of India must be well versed with the technology that may provide solution to localities having no sewer network or open defecation problems. These topics are either missing in the curriculums or are given too little weight. The curriculum teaches a technology which is not in practices, rather inappropriate for the environment in which it has to be applied.

Of course, with time as the country will transform to a developed country, it will also adopt the same advanced technology. Yet the country has to undergo a long journey from a developing country to a developed country. At this juncture of time it needs low cost sanitary engineering technology. Hence it is recommended that the universities must amend their sanitary engineering curriculums accordingly. It is important to be noted that low cost sanitary technology will be developed by indigenous research only as it is an exclusively indigenous requirement. The academicians and university statuary bodies must consider the issue very seriously. The curriculums must be soon amended appropriately. This is an important step the country will have to take as it has to transform to a developed country.

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