

Examining the Research and Technological Impact of Survismeter

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ABSTRACT

The chemical solutions are backbone of industrial formulation as this helps in manufacturing of various industrial products. Each formulation goes through the structural changes which requires precise instruments to capture the structural characteristics. Understanding these structural changes are also active area of research. Survismeter was designed in an academic setting in India to understand structural characteristics of chemical solutions. The instrument was further modified and was successfully transferred to a firm. It was demonstrated that the instrument not only has relevance for chemical sciences but has functional relevance in different domains especially pharmaceuticals, nanomaterials, functional materials formulations and biophysics. The study examines the research impact of the instrument 'Survismeter'. This paper seeks to analyze the use, development and publications indexed in the database of Scopus to understand the impact of this instrument. Furthermore, there is also focus on the patents granted to this instrument and its commercial transfer.

Keywords: Survismeter, Friccohesity, Borosil, Patent, Instrument.

INTRODUCTION

Background

Borosil Mansingh Survismeter (where the term Mansingh refers to scientist/inventor/innovator Man Singh), is a green science Trusted Sustainable Analytical Device (TSAD) used for measuring surface tension, interfacial tension, wetting coefficient, particle surface area and size, viscosity and friccohesity simultaneously of aqueous, non-aqueous, aprotic dipolar, polar, protic polar and non-polar solvents and mixtures within wider ranges. Figure 1 and Figure 2 highlights the schematic and physical structure of this instrument

Survismeter is based on the combination of three terms sur + vis + meter that means surface tension, viscosity and meter (measuring parameter). It works on the theory of R4M4 [Reduce Reuse Recycle Redesign–Multipurpose Multidimensional Multifaceted Multitracking] of materials and methods with highly précis and accurate experimental results. The instrument can be used in the quality analysis of various products used in agrochemicals, biochemical, pharmaceuticals, cosmetics, petroleum and oils, polymer and proteins, food and beverages, inks, sol-gels, soaps and detergents, insecticides, pesticides, colloids, emulsions,

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lubricating, viscous materials (high or moderately). The focus of this device is on surface tension, viscosity, interfacial tension and wetting coefficient determinations.^[1-12] The study examines the impact of this instrument in academic research.

Objective and Study Method

The study attempts to capture the importance of Survismeter in research and industry by examining research outputs emerging from usage of this instrument. Chronological publication growth pattern (as time series); Authorship pattern; Geographical scattering of publication are examined in this context. Further through personal interviews with the inventor and examining the patents granted to this instrument and its commercial transfer, the study attempts to draw the research and commercial impact of this instrument.

Findings

There were thirty-two research papers that was identified based on the instrument 'Survismeter'. The papers were identified based on the search string 'Survismeter' applied in the keyword field covering the period 2005 to 2019. Figure 3 shows the chronological order of publications as per the Scopus database from the year 2005 to 2019 with respect to term Survismeter. It may be possible that some paper published earlier has not been indexed in the Scopus database.

Most of the documents published are in the form of articles (approximately 97%) and the remaining as conference papers. The progressive decline of the research papers can possibly be understood when one looks more closely at the characteristics

of the papers. Most of the papers are affiliated to University of Delhi (28) which is also where the inventor was affiliated followed by the Central University of Gujarat (6) where he had strong linkages. Thus the inventor involvement was a key factor in producing research papers.

It is also interesting to see single paper affiliation of some foreign university namely King Abdulaziz University (Saudi Arabia) and Kyoto University (Japan). It is not clear whether these universities had this instrument as they were joint publications with the lead author. The influential role of the inventor can be clearly observed. Out of 32 papers, 17 papers were published in journals indexed in SCI (Table 1). In spite of various contestations, Impact factor is still seen as a indicator of quality of research papers.

Disciplinary dispersion is high as can be seen from the Table 2. It might be due to publication in journals that have multi-disciplinary presence.

There were overall 172 citations received by the 32 papers; approximately 5 citations per paper. This show a reasonably good reception of the papers. This however has to be factored with high self-citation which is emerging from mainly the closed group that was involved in working in this instrument. Table 3 highlights this distribution of key location of citation.

Based on extensive discussions with inventor and also examining key sources, the impact of research of this instrument was further identified. Table 4 highlights the key essential aspects of that.

The instrument has been useful in research covering Anti-wrinkle creams, micellar food and O₂ intake of daily use materials; Biomedical, biochemical and biophysical activities in nonpolar, polar, buffer media; Determine the antioxidant activity of day today used molecules; Quality check of daily used soap and detergents; Identification of saturated and unsaturated edible oil; Adhesive ability of house interior materials paints and pigments; Efficiency check of toothpaste; Efficiency determination of jaundice checkup; Wettability ability of eye lotion/contact lens cleansing; Saltwater interaction and water binding salt ability; Glycerine flower enhancing life lotion; Determining polymer molecular weight for protein and salt binding/capping; Determining Au, Pt, TiO₂, ZnO, MgO NPs capping ability; Casein protein dispersion state in water, buffer as variable pH; Nanodispersion of antioxidant molecules and casein lemon juice coagulation study; Organic pesticides wettability and pest killing ability; and Ink wettability, digital ink study and Activity of entropy is acentropy.

The impact of Survismeter on research activities can be determined from the previous discussion. In industrial chemical formulation wherein, the chemical solutions are backbone.

All these chemical formulations are used in manufacturing of wide range of industrial products such as plastics, textiles, paper, food products, inks, glass wares, washing agents, ICs and more. Each formulation goes through structural changes and has changes in physicochemical properties. Due to the need of understanding these properties, the particular instrument technology is important because of its easy handling, sampling, data process, sample deloading and accuracy with high precision.

The instrument helps in determining numerous physicochemical parameters (as surface tension, viscosity, interfacial tension, wetting coefficient, contact angle between solid glass wall and liquid interfaces, frictional force theory, activation Energy, kinetic energy of liquid flow, Gibbs free energy, surface area, dipole moment and more) with a single apparatus. In addition, it also helps in characterizing the liquid mixtures of supramolecular chemistry, biopolymers, biotechnological processes and molecular interacting engineering of the bimolecular devices, tracking interacting molecular forces, water binding capacities and structural changes during processes.

Moving beyond Scientific Research

The importance of this instrument identified in research was a key driver for developing this further for commercial application. It was transferred to Borosil Glassworks Ltd; a

Table 1: Scientific Journals Active in the Field.

Name of Journal	IF	Number of Documents Published
Journal of Dispersion Science and Technology	1.6	5
Journal of Chemistry	1.79	4
Journal of Molecular Liquids	4.77	3
Surface and Interface Analysis	1.393	3
International Journal of Thermodynamics	0.37	2

Source: Compiled from various sources

Table 2: Various Disciplines covered under the term Survismeter.

Subject/Discipline	Number of Documents
Chemistry	23
Materials Science	18
Physics and Astronomy	17
Social Sciences	4
Chemical Engineering	3
Engineering	3
Biochemistry, Genetics and Molecular Biology	2

Source: Scopus database

Table 3: Geographical Distribution based on cited documents.

Country/Territory	Number of Published Documents
India	122
China	19
Saudi Arabia	10
Nepal	7
United States	6
Iran	4
Tunisia	4
Brazil	3
Italy	3
Russian Federation	3

Source: Scopus database

Table 4: Survismeter in Academia, Syllabus, Countries and Books.

Survismeter in Academics		
Course	University/Institute	Number of Published work
Ph.D.	Delhi University (DU)	05
Ph.D.	Himachal Pradesh University	05
Ph.D.	Central University of Gujarat (CUG)	10
M.Phil.	University of Chittagong, Bangladesh	02
M.Phil.	Central University of Gujarat (CUG)	10

Places and Platforms where Survismeter is being used and discussed

S.no.	Name
1	University of Chittagong, Bangladesh
2	Rivers State University of Science and Technology, Port Harcourt Nigeria
3	Tribhuvan University, Kirtipur
4	Kathmandu University, Dhulikhel
5	USKW Warsaw Poland
6	Indonesia
7	USA
8	Central University of Gujarat (CUG), Gandhinagar Gujarat India
9	https://www.facebook.com/Survismeter-Research-Group-773533496155332/

And in India Survismeter has been added in All India Council for Technical Education (AICTE) syllabus, New Delhi

Source: Author's Compilation

highly regarded company in India in scientific glass producer and has presence in laboratory glass apparatus to consumer glass products. Commercial transfer of the product to this company and patents were granted in three patent office's namely Indian, European and Singapore patent office highlights the importance of the instrument. The product was classified as 'Borosil Mansingh Survismeter' by the company.

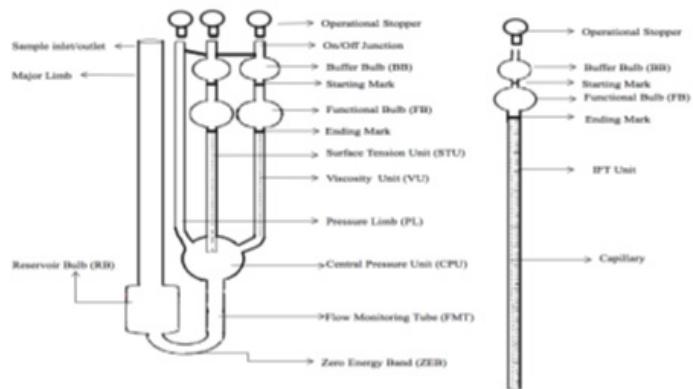


Figure 1: Schematic diagram of Borosil Mansingh Survismeter | Source: Patel (2016).

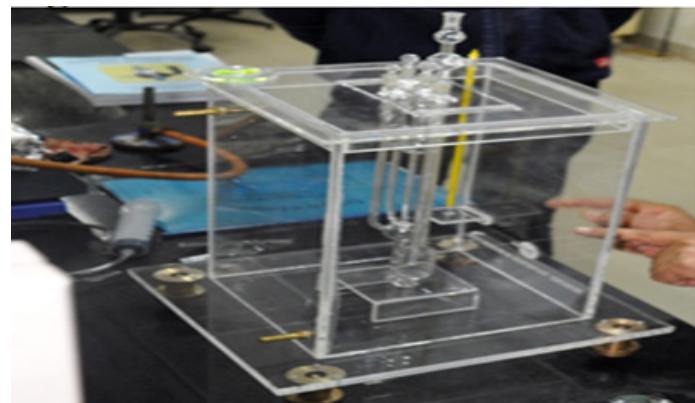


Figure 2: Physical Structure of Borosil Mansingh Survismeter | Source: The inventor.



Figure 3: Year-wise Distribution of Documents | Source: Scopus database.

The patent claim on the European patent office essentially was on an instrument having one or more capillary for determining viscosity, surface tension and dipole moment of liquid. In the Singapore patent office, the claim granted covered it under measurement of surface tension and viscosity of solutions. The Indian patent office claim covered both the aspects as in the two patent office.

DISCUSSION

The study provides an insight of an instrument that was developed within a laboratory and was successfully transferred to a reputed company. The study identifies this instrument

as a useful research apparatus that had influential impact within a closed user group which was led by the inventor. This can be seen from the analysis of the research papers. The citation impact was more dispersed indicating the papers drew attention to important aspects of characterization that was useful to the larger community. The patents granted to this instrument indicated that it had satisfied the criteria of novelty, non-obviousness and utility, the three key aspects that are judged in granting a patent. The applications as identified in research provided the impetus to develop this and commercialize it.

CONCLUSION

The extent the instrument was found useful by the company is not possible to be identified by the type of analysis undertaken. The research activity primarily restricted within a close user group led by the inventor who is also the author of most of the papers also shows that the instrument may have had limited research impact. On the other hand, the patents granted, the product being commercialized by a reputed company and it being recognized in the Indian Technical curriculum highlights the importance of this instrument. Further critical study with other similar instruments developed in an academia setting and transferred commercially would provide a more informed judgment of this instrument.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

TSAD: Trusted Sustainable Analytical Device; **R4M4:** Reduce Reuse Recycle Redesign–Multipurpose Multidimensional Multifaceted Multitracking; **NPs:** Nanoparticles.

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