

High Voltage Electrostatic Slides in Electrostatics Teaching: Are They Still Relevant in the Era of Numerical Simulation Tools?

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Abstract:

The teaching of electrostatics has been a cornerstone of physics and engineering education for centuries [1][2][3][4]. Its focus has evolved significantly, transitioning from Ganot's practical approach in the 19th century to a predominantly theoretical treatment in the 20th century, often presented as an introductory course to more complex electromagnetic problems. By the time the industrial applications of electrostatics, particularly in the context of plastics manufacturing, became prominent in the mid-20th century, practical electrostatics had largely disappeared from student textbooks.

However, during the latter half of the 20th century, specialized companies began to develop tools and kits to support science education in schools and universities [5]. In Spain, ENOSA [6] became a notable example, producing a wide range of educational materials for teaching science. Among their contributions were innovative materials designed to demonstrate electrostatic principles. Notably, ENOSA developed slides for visualizing electrostatic fields using specific electrode arrangements, an overhead projector, and a Van de Graaff generator. These slides contained cells filled with insulating oil and magnetic insulating particles, which visually aligned and moved when subjected to high-voltage potentials applied to the electrodes.

This work outlines a brief history of these electrostatic demonstration slides and provides a detailed description of how they were designed to be used, based on ENOSA's reference materials and practical experience. Furthermore, it compares the educational value of these physical demonstrations with modern simulation techniques, such as finite element software.

The central question of this study is whether these electrostatic slides remain relevant in contemporary electrostatics courses. Are these physical demonstration tools worth the effort and risks associated with their setup, or have finite element simulations in the classroom rendered them obsolete? From the students' perspective, what are the educational benefits of these traditional tools compared to modern software-based approaches?

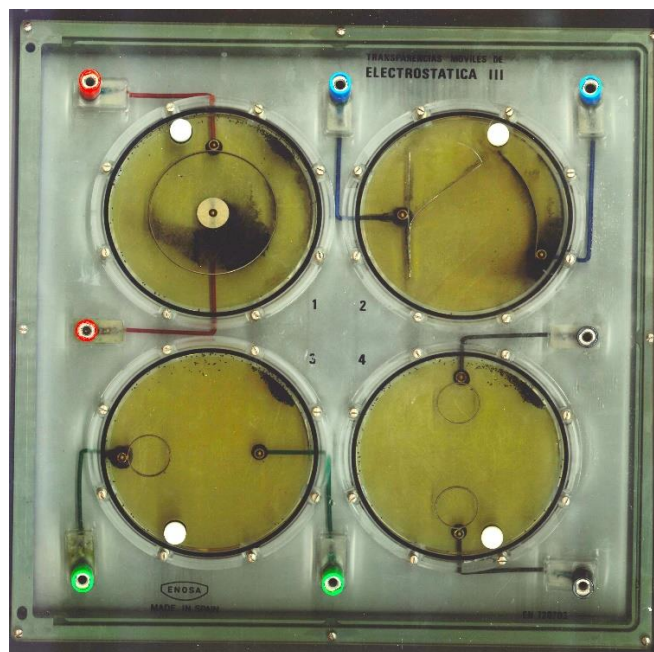


Figure 1. Example of a slide for electrostatic teaching.

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