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Development of Electrocoagulation system of fuel using supporting medium for identification of volatile compound products

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INTRODUCTION & AIM

This study introduces an electrocoagulation (EC) approach with a supporting medium, developed for investigating the stability of a biodiesel in terms of biodegradability advantages under electrochemical treatment. Gas chromatography–mass spectrometry (GC-MS) was utilized for volatile compound profile identification to analyze samples before and after the EC reaction. The main and minor compounds that were identified after EC treatment included branched cyclic alkanes, branched alkanes, straight-chain alkanes, aromatic compounds, aldehydes, ketones, esters, alkenes, alkynes, halogens, oxygenated compounds, and heterocyclic compounds, respectively, as the summation of peak areas of different compound classes.

The selected reaction conditions of 12 V and 60 minutes, the total peak area of compounds containing, e.g., 5-undecene, 1-octadecyne, dodecanoic acid methyl ester, and 2,4-Dichloro-5-fluorobenzyl alcohol increased significantly to 1.8 to 5.5×10⁹ counts per/s, compared with 0 counts/s for the control of the peak areas. The most focused peak areas of alkene, alkyne, esters, and alcohol saw an increase of up to 33% of the total peak areas, observed after the selected EC condition in the experiment. Compounds with higher peak areas were the concentrated compounds mentioned, with retention indices ranging from 1073 to 1506.

The EC treatment predominantly increased the contents of straight and branched alkene, alkyne, and alcohols, while decreasing the content of branched cyclic alkanes. The developed two-phase electrocoagulation system is anticipated to find applications in investigating fuel properties in the future.

METHOD

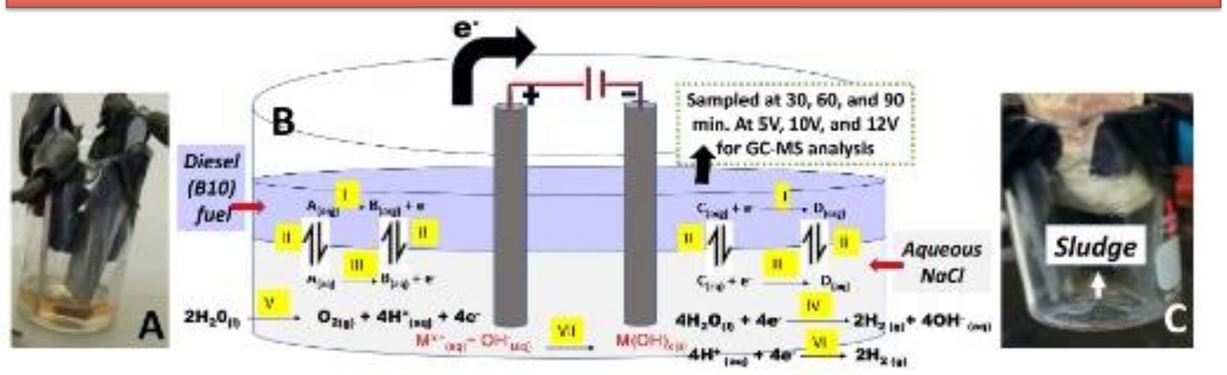

Figure1. (A) Experimental set up of the two-phase EC system,**(B)** The possible mechanisms of the approach for conversion of compounds A and C into compounds B and D, respectively,according to the reduction and oxidation reactions **(i)** in B10 diesel phase or **(iii)** in $NaCl_{(aq)}$ phase with **(ii)** the compound partitioning between the two-phases with **(iv),(v)** and **(vi)** showing formation of $H_{2\ (g)}$ and $O_{2\ (g)}$ and sludge, respectively, and **(C)** the sludge after the EC.

Name of compound	Retention Index	Peak area
Cyclohexanol, 5-methyl-2-(1-methylethyl)-,(1α,2β,5α)-	1155	272276992
Cyclohexane, pentyl-(2)	1156	120481760
2,3-Dimethyldecane	1170	111766568
Napthalene, decahydro-1,6-dimethyl-	1179	117260792
Undecane	1184	510953664
Undecane, 5,7-dimethyl	1188	787260032
Undecane, 4,6-dimethyl	1198	215877280
Cyclohexane, hexyl-	1220	158736256

Table1. Major compound profiles of the diesel sample

RESULTS & DISCUSSION

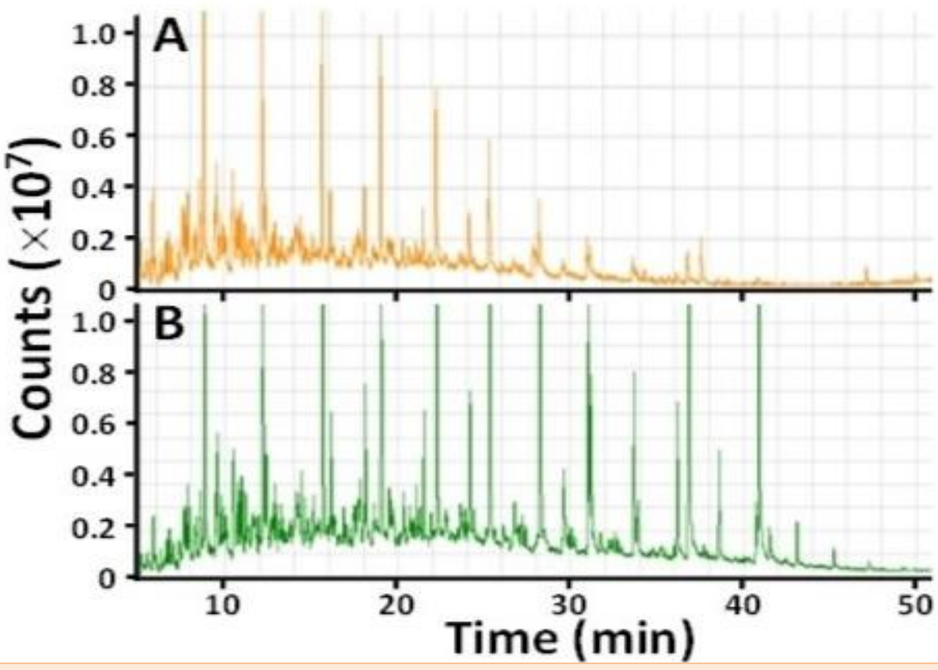

Figure 2. Total ion chromatograms of the diesel sample **(A)** control and **(B)** with the two-phase EC treatment at 12 V for 60 min.

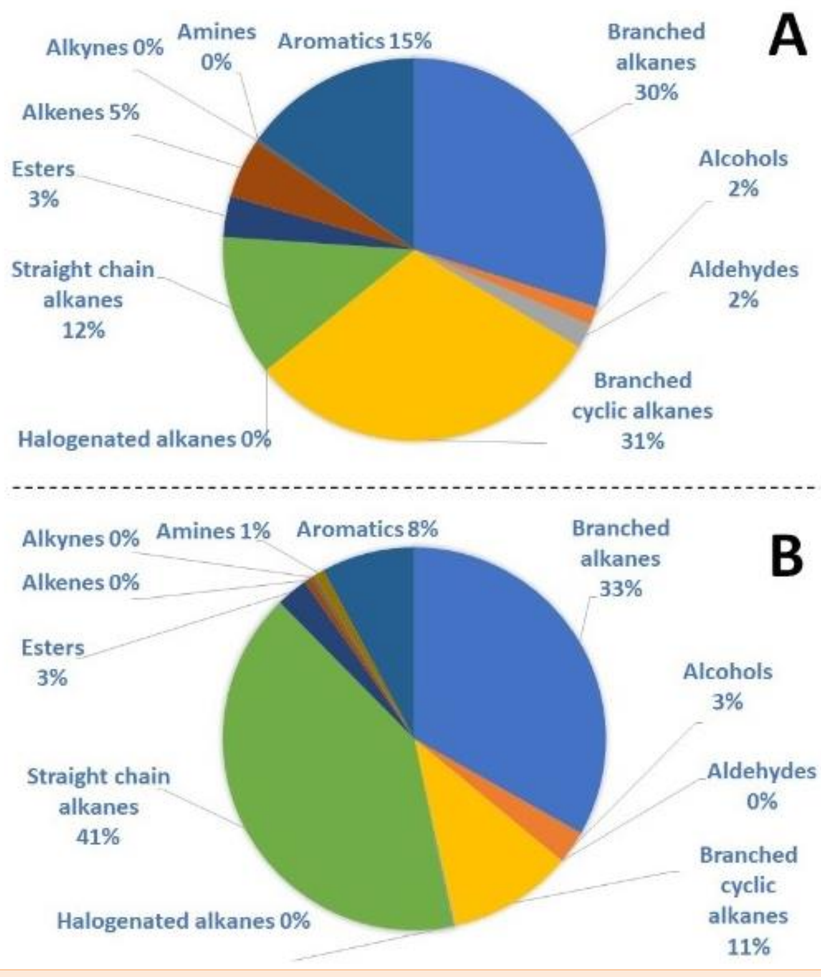

Figure 3. Summation of peak areas of different compound classes of the diesel sample**(A)** without and **(B)** with the EC treatment at 12 V for 60 min.

CONCLUSION

This versatile system, designed for the electrochemical treatment of biodiesel, offers a cost-effective and efficient approach for evaluating the stability and composition of various fuel types. Its adaptability and simplicity make it a promising tool for exploring and understanding the characteristics of different fuels, providing valuable insights for fuel quality assessment and optimization.

FUTURE WORK / REFERENCES

[1] C. S. Hsu, G. J. Dechert, D. J. Abbott, M. W. Genowitz, R. Barbour, Chemistry of Diesel Fuels,CRC Press Florida, 2000, p.61–76.
[2] K. J. Johnson,S. L. Rose-Pehrsson,R. E. Morris,Energy Fuels 2004,18, p.844–850