

ASSESSING THE FILTRATION EFFICIENCY OF FACEMASK FILTER MATERIALS FOR THE PREVENTION OF COVID-19



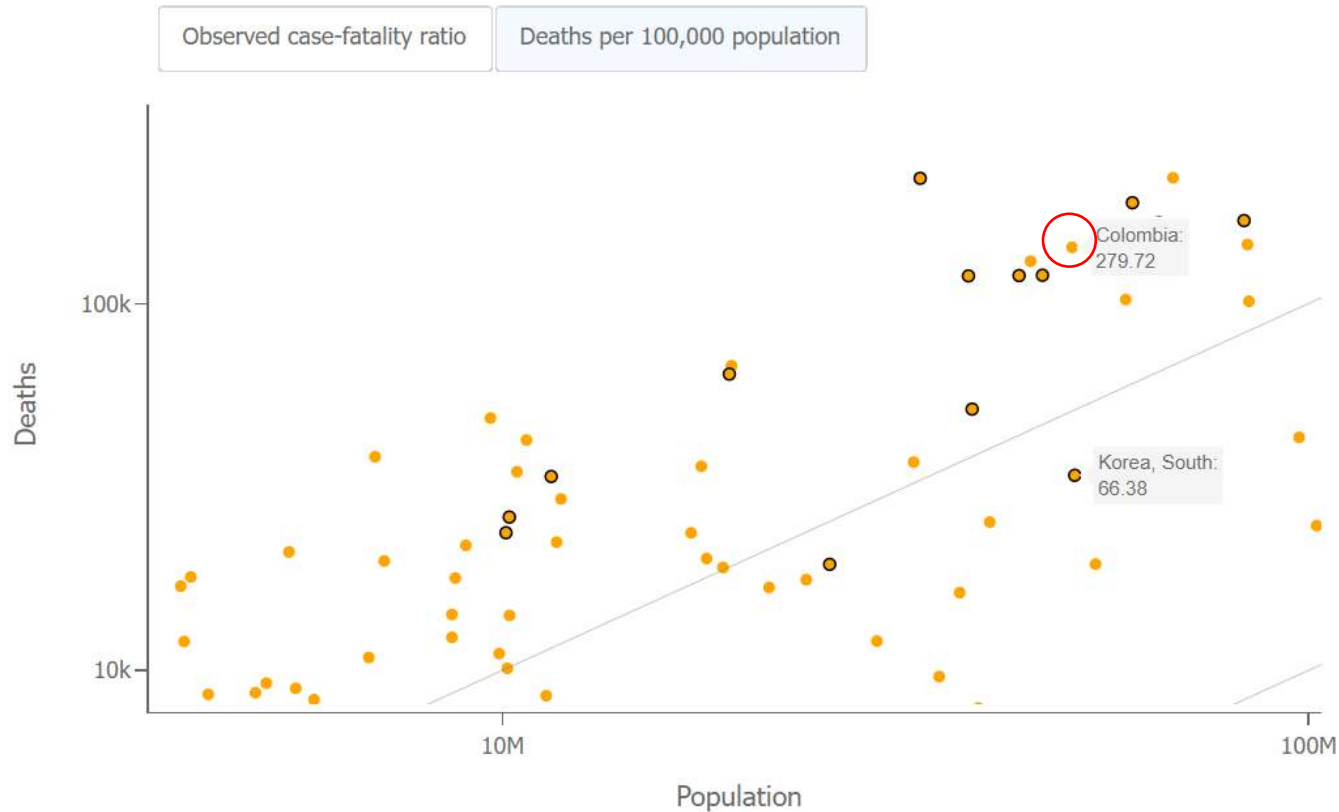
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Motivation



- Colombia has been hit hard by covid -19, with 6,358,232 cases 142,329 deaths and a case fatality ratio of 2.2%
- Deaths per 100 k inhabitants are 4.2 times higher than countries of similar population

Source : The Johns Hopkins Coronavirus Resource Center (2023)



Motivation



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Covid-19 en Colombia: del 29 de enero al 4 de febrero se registraron 868 nuevos contagios

El informe del Ministerio de Salud también señaló que 12 colombianos fallecieron a causa de la enfermedad en la última semana

10 Feb, 2023 [Compartir](#)



Covid-19 en Colombia: del 29 de enero al 4 de febrero se registraron 868 nuevos contagios. Infobae.

- In 2023 COVID still an issue in the world and in Colombia

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NEWS | 01 February 2023

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The World Health Organization has decided the crisis isn't over yet – but it's at a transition point.

[David Adam](#)

Motivation

- Facemasks are still needed and will likely be a part of our day to day for years to come.
- Our study is aimed to assess the efficiency of face masks materials that are sold in Colombia.



Bogotá

Atención: en Bogotá vuelve el uso obligatorio de tapabocas en transporte público, ¿por qué?

La medida fue anunciada por el Distrito en la mañana de este lunes y busca hacerle frente al incremento en la contaminación del aire.

21/2/2023



El uso de tapabocas en el transporte público es obligatorio a nivel nacional, pero la medida trae consigo los desafíos de cumplirlo en la práctica. Foto: Juan Carlos Ochoa / Gensara

Para hacerle frente a la contingencia ambiental que está atravesando Bogotá, la Alcaldía Mayor anunció que el uso del tapabocas será obligatorio en el transporte público, que no solo incluye el Transmilenio y los buses del SITP, sino también taxis, cables y buses intermunicipales.



Materials and methods

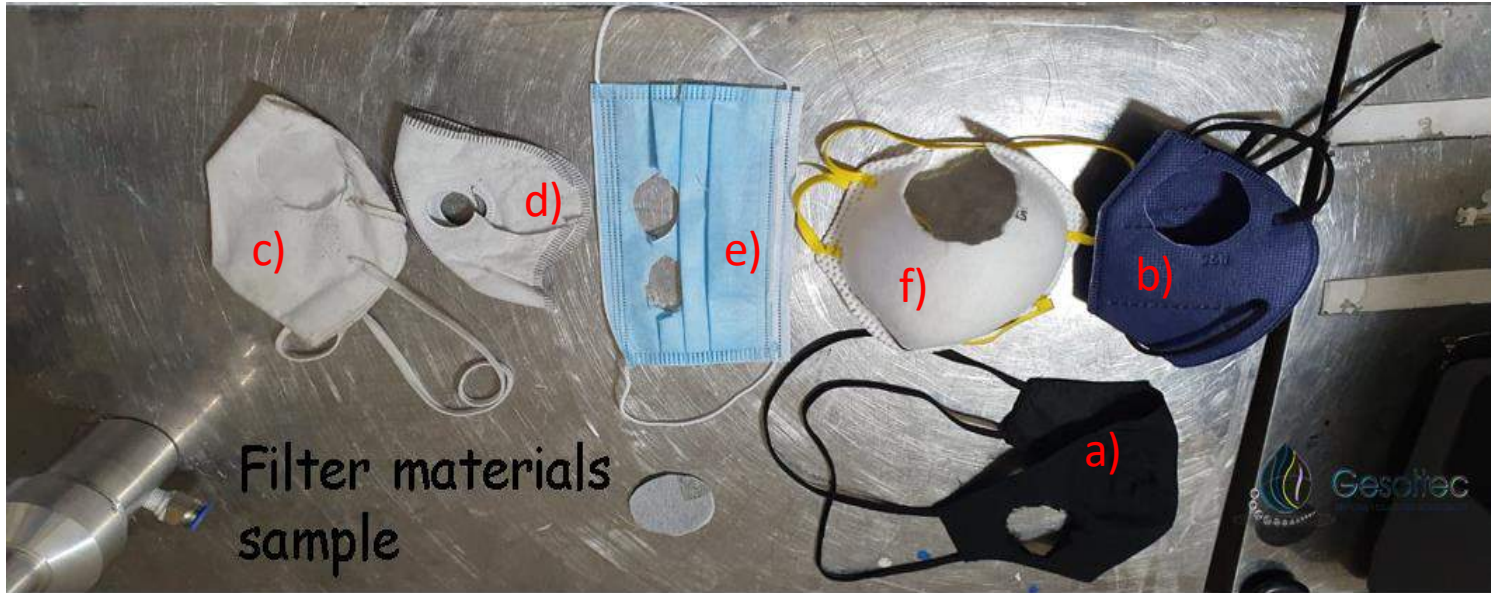


Fig 1. Mask Materials tested
a) Homemade cotton mask
b) N95
c) KN95
d) Cotton-polyester
e) Surgical mask
f) Certified N95



Fig 2. Filter materials were cut and placed on a filter holder for testing



Materials and methods – Experimental Setup

Experimental set up

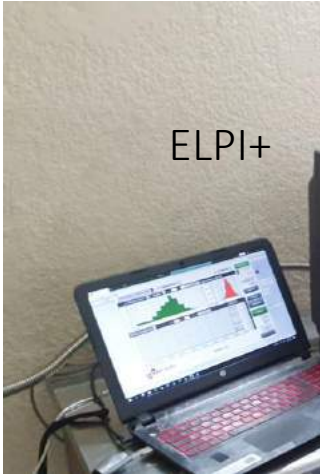
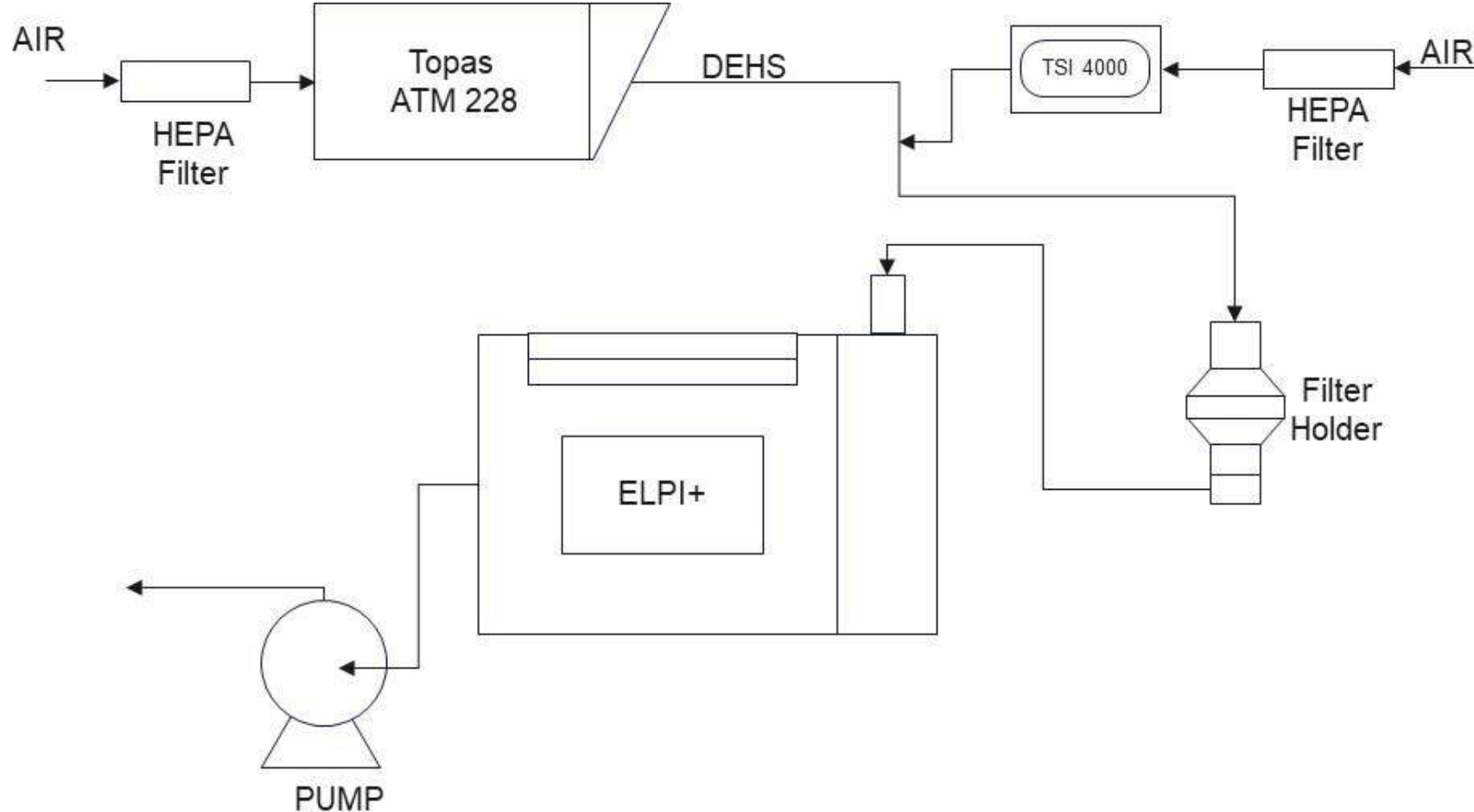


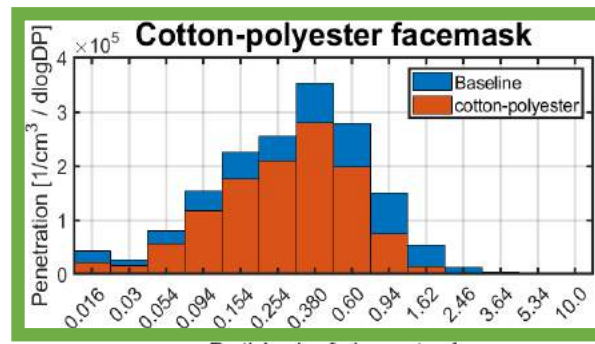
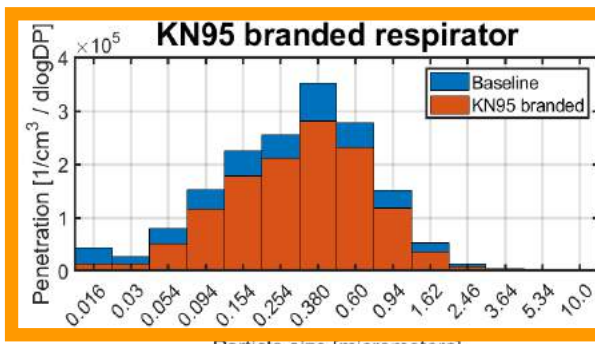
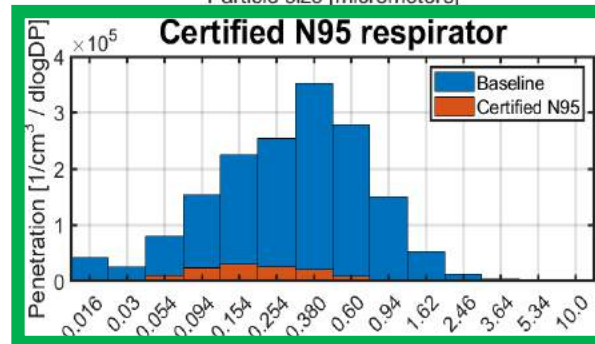
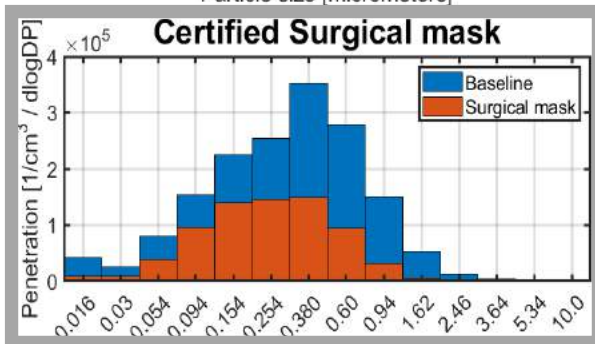
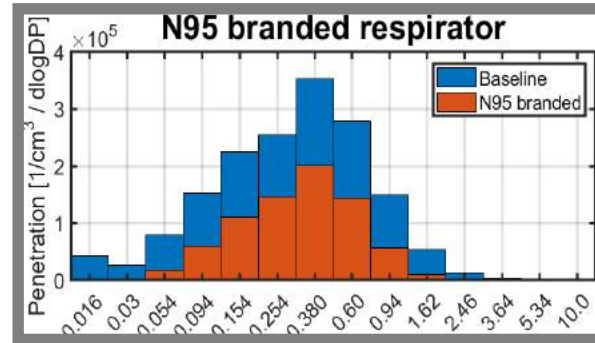
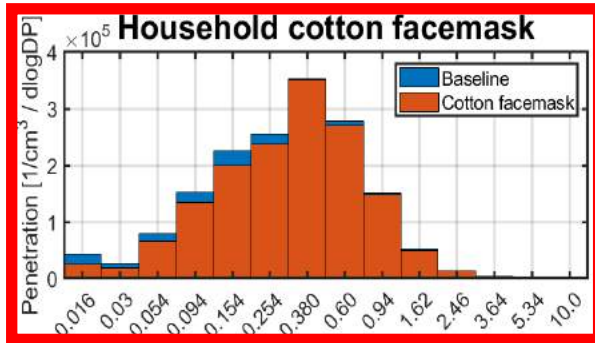
Fig 3. We used Pressure Impact aerosol mass and Ethyl-Hexyl-Sel generated with and without filter



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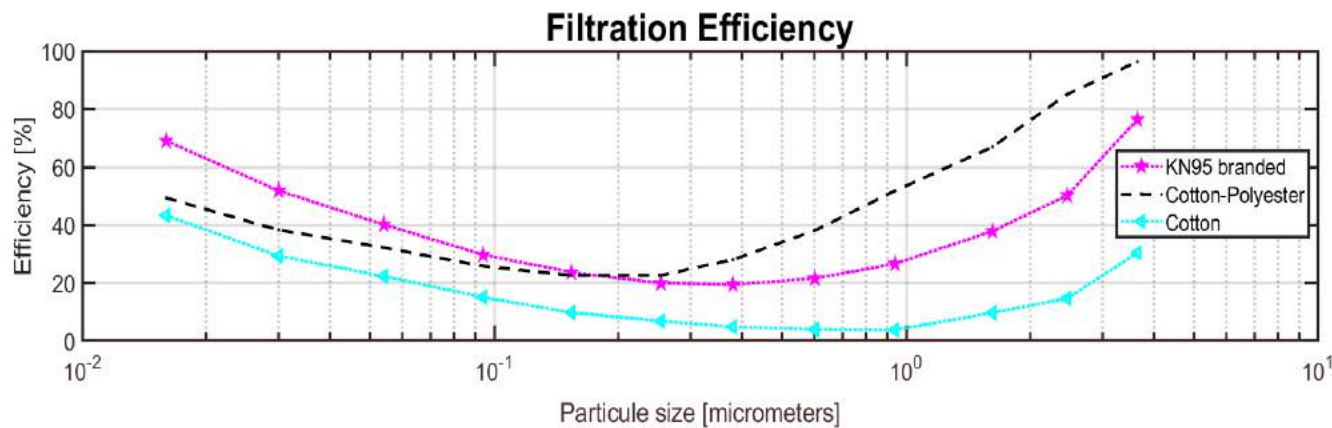
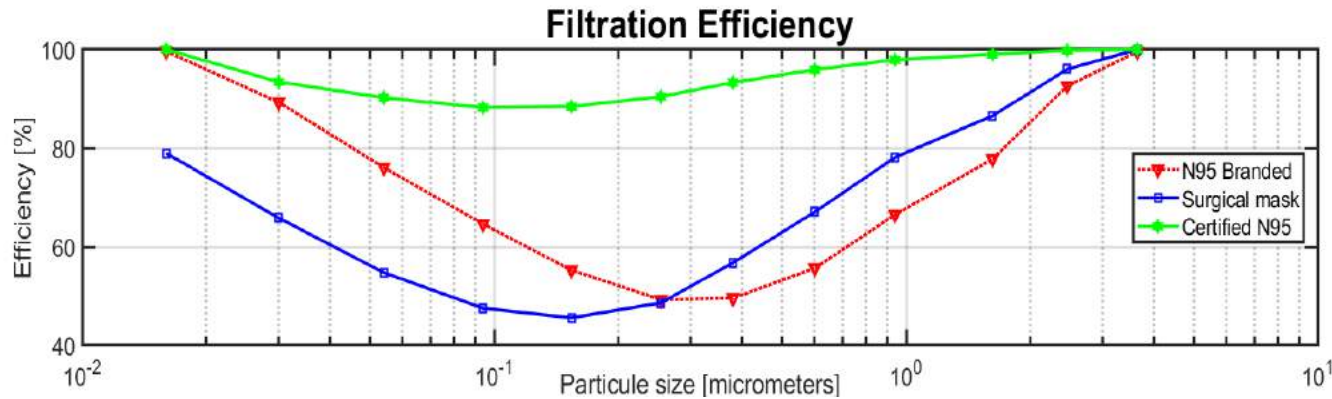
Results - Penetration by particle size



- The particle distribution generated with the TOPAS ATM (baseline in blue) had mean a particle number concentration of 117000 particles cm^{-3} with diameters between 18.6 nm to 1.91 μm .
- The homemade mask didn't stop the aerosol. Almost complete penetration occurred.
- KN95 branded respirator and the cotton polyester mask did almost as bad as the homemade cotton mask
- The certified surgical mask and the N95 branded respirator had about 30% penetration and both stopped very small particles (< than 0.05 μm)
- The N95 certified respirator showed less than 5% penetration as expected, in all sizes



Results - Filtration efficiency by particle size



- The mask filter materials had efficiencies between 19 and 95%.
- The certified N95 respirator showed the best results, with a collection efficiency of 95%. Lowest efficiency was 90% for particles of about 0.1 um diameter
- The N95 Branded Respirator and certified surgical mask showed similar efficiencies with 72 and 71%, respectively. The first been a better for smaller particles, less than 0.1 um in diameter
- The cotton-polyester filter had an efficiency of 52%.
- The KN95 and cotton masks showed the lowest efficiencies in the experiment, values of 38 and 19%, respectively.



How our results compare with other studies?

Author	Year	Efficiency
Davies <i>et al.</i>	2013	Cotton T-shirt: 69.42% Scarf: 62% Tea towel: 83% Pillowcase: 61% Surgical: 96% Cotton mix: 74% Silk: 58%
Patel <i>et al.</i>	2016	N95: 80-90% sealed N95: 100% Surgical mask: ~ 50%
Morais <i>et al.</i>	2021	N95: 98% Surgical: 89% Nonwoven: 78% Homemade: 20-60%
This study	2021	N95: 95% N95 branded: 72% Surgical mask: 71% Cotton-polyester: 52% KN95: 38% Cotton: 19%

- The certified N95 masks offers the best level of protection
- Surgical masks showed a moderate degree of protection, with collection efficiencies between 50-96%.
- Homemade mask masks, cotton masks and cotton-polyester masks are difficult to compare with other studies. However, it is possible to identify that this types of filter materials provide low levels of protection, with efficiencies between 19-74%.



Conclusions

- The efficiency of the different filter materials assessed varied between 19 to 95 % for particles between 18.6 nm to 1.91 μm .
- Cotton, cotton-polyester and KN95 masks sold in Colombia do not provide good protection for aerosols lower than 1 μm .
- The best filter materials are the ones used to make certified surgical and certified N95 masks, which have average collection efficiencies for aerosols below 1 μm of approximately 61% and 93%, respectively





Questions?

Más información



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