We were invaded by aliens and they told us that they have some formula that will destroy all plastics, rubber, and any other petroleum-based materials. And I'd like to learn to build cables that isolate and insulate electric cables with a material that does not come from petroleum. Can you help me with that?

**ChatGPT said:**

Thought for 45 seconds

Below is a practical “petro-free” playbook that engineers in the late-1800s would recognize—updated with today’s bio-based and mineral alternatives that survive your alien anti-plastic weapon.

**1. What an insulating system must do**

| **Requirement** | **Target value** | **Proven non-petroleum ways to hit it** |
| --- | --- | --- |
| Dielectric strength | ≥ 15 kV /mm for thin enamel; ≥ 3 kV /mm for bulk layers | Shellac/cellulose enamels, mica paper, vegetable-oil–impregnated kraft |
| Thermal endurance | 90 – 120 °C (class A/B) for electronics, 70 °C for house wiring | Mica/glass tape + shellac varnish; castor-oil nylon 11 extrusion |
| Flexibility | Survive ≥ 5× cable Ø bending without cracks | Braided cotton/hemp sleeve over enamel; bio-nylon 11 jacket |
| Moisture & bio-attack | Resist ≤ 5 % water uptake, ≤ 5 % fungus growth in 28 days | Natural ester impregnation (FR3®), wax–rosin seal coat |
| Mechanical protection | Abrasion & rodent proof | Tempered-glass braid or lead sheath + jute/steel armor |

**2. Materials you can actually source now**

| **Layer** | **Candidate** | **Why it works** | **Notes** |
| --- | --- | --- | --- |
| **Enamel (direct on wire)** | • Shellac (in ethanol) • Cellulose acetate or nitrate (plant pulp) | Hard, high-dielectric, melts at ≈150 °C | Multiple dip-&-bake coats (≈ 120 °C) to ≥ 50 µm |
| **Tape / Wrap** | • Kraft or Manila paper (pure cellulose) • Mica paper (phlogopite, muscovite) • Woven glass yarn | Cheap; mica is class H (180 °C) | Lap-wrap at 20 % overlap |
| **Impregnant / Varnish** | • Natural ester dielectric oils (e.g. **FR3®** from soybean/rapeseed) [cargill.com](https://www.cargill.com/bioindustrial/dielectric-fluids/fr3-fluid?utm_source=chatgpt.com)[cargill.com](https://www.cargill.com/bioindustrial/fr3-fluid/fr3-fluid-technical-details?utm_source=chatgpt.com) | High flash-point, biodegradable, ASTM-accepted |  |
| **Jacket / Sheath** | • Polyamide 11 (**Rilsan® PA11**) made from castor oil [Home | Arkema Global](https://www.arkema.com/usa/en/product/technicalpolymers/rilsan-family-products/rilsan-pa11/?utm_source=chatgpt.com)[Arkema](https://hpp.arkema.com/files/live/sites/shared_arkema/files/downloads/HPP/market-brochures/wire-and-cable/2022%20-%20Specialty%20polyamides%20for%20wire%20%26%20cable.pdf?utm_source=chatgpt.com) | Extrudes like nylon 12, UV/rodent/abrasion resistant; already used in offshore umbilicals and cable ties [HellermannTyton](https://www.hellermanntyton.us/products/111-00884/?utm_source=chatgpt.com) |  |
| **High-integrity outer** | • Spun tempered-glass braid + shellac • Lead sheath (classic PILC design) [Electric Energy Online](https://electricenergyonline.com/energy/magazine/88/article/PILC-cable.htm?utm_source=chatgpt.com) | Glass survives 400 °C; lead gives full moisture block |  |

*(PA 11 is still a “plastic”, but not petroleum-derived; if the alien chemistry targets* ***all*** *polymers, rely on the paper/mica/glass + lead route.)*

**3. Two complete cable recipes**

**3.1 Low-voltage flexible cord (lamp, USB-power, sensors)**

1. **Conductor** Strand or solid annealed copper, 20–16 AWG.
2. **Primary enamel** Dip in 30 % shellac in ethanol, bake 120 °C × 10 min; repeat 3×.
3. **Braid sleeve** Pull the wire through a loose cotton or hemp braid.
4. **Impregnation** Vacuum-soak the braided wire in warmed FR3® (60 °C, –50 kPa, 30 min) then let cool; wipe off excess.
5. **Jacket** Optional: over-braid second cotton layer and brush on 70 : 30 bees-wax : rosin melt for water seal.

*Specs:* ~300 V rating, bend radius ≈ 4× cable Ø, operating 0–90 °C.

**3.2 Household or feeder cable (5–25 kV class)**

1. **Conductor** Compressed concentric copper.
2. **Paper lapping** Apply 5–15 layers of 0.1 mm kraft paper at 20 % overlap.
3. **Dry & evacuate** Bake 12 h at 90 °C while pulling –90 kPa to remove moisture.
4. **Ester impregnation** Switch vacuum pot to FR3® at 80 °C; hold 1 h; release to slight pressure to force oil in.
5. **Lead sheath** Hot-extrude 2–3 mm lead tube over the paper core.
6. **Armour / outer** Bedding of jute, helically wrapped steel tape, asphalt or bitumen (plant-tar) outer coat.

Historic PILC lines built this way still run after 70 years; swapping mineral oil for vegetable ester keeps the aliens at bay.

*Specs:* With 2.5 mm total paper, breakdown ≈ 20 kV rms; sheath temp limit ≈ 90 °C.

**4. Lab-bench extrusion with bio-nylon 11 (for modern flexibility)**

If you have an extruder (desktop 20 mm screw or recycled 3-D printer-based line):

1. Dry **PA 11** pellets 80 °C / 4 h.
2. Barrel 210 → 190 °C; die 190 °C.
3. Pull copper core through a 1 mm annular die; line speed ≈ 20 m min⁻¹.
4. Quench in 40 °C water bath, then post-anneal 80 °C × 2 h to relieve stress.

Bio-nylon 11 jacket alone meets UL VW-1 flame and -40 °C cold-bend; add mica or paper underlay if you need higher voltage or temperature.

**5. Connectors & accessories without petro-plastics**

* **Terminal blocks:** glazed ceramic or steatite.
* **Cable glands:** bronze body + hemp packing soaked in linseed oil.
* **Tie-wraps:** castor-oil PA 11 versions already on the market [HellermannTyton](https://www.hellermanntyton.us/products/111-00884/?utm_source=chatgpt.com).
* **Potting / strain relief:** boiled pine rosin + beeswax 50 : 50; sets hard but re-meltable for repairs.

**6. Testing checklist**

1. **Megger/hipot** at 2× rated RMS voltage for 1 minute (dry & after 24 h soak).
2. **Mandrel bend** 5× Ø at –20 °C, check for cracks.
3. **Dielectric loss factor (tan δ)** under rated load, 60 Hz; compare < 2 % for paper-ester, < 0.5 % for PA 11.
4. **Accelerated ageing** 96 h at 110 °C; repeat hipot.

**Where to learn more / source materials**

* **Transformer-grade natural esters** – Cargill *FR3* technical datasheets [cargill.com](https://www.cargill.com/bioindustrial/fr3-fluid/fr3-fluid-technical-details?utm_source=chatgpt.com)
* **Castor-oil nylon 11** – Arkema *Rilsan PA 11* wire-&-cable brochure (free PDF) [Arkema](https://hpp.arkema.com/files/live/sites/shared_arkema/files/downloads/HPP/market-brochures/wire-and-cable/2022%20-%20Specialty%20polyamides%20for%20wire%20%26%20cable.pdf?utm_source=chatgpt.com)
* **Historic construction details** – IEEE/Wiley “Cables: A Chronological Perspective” for PILC design [Wiley Catalog Images](https://catalogimages.wiley.com/images/db/pdf/0780311965.excerpt.pdf?utm_source=chatgpt.com)

**Bottom line:** 100 % petroleum-free, alien-proof cables are not science fiction—our ancestors built them with copper, paper, lead, natural resins and oils. Add modern castor-oil nylon 11 or glass braids when you need greater flexibility or heat, and you can wire your post-invasion world just fine. Let me know which voltage/current range you plan to tackle and what tools you have on hand; I can work out exact layer thicknesses, winding angles, or extrusion settings for your first prototype.

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