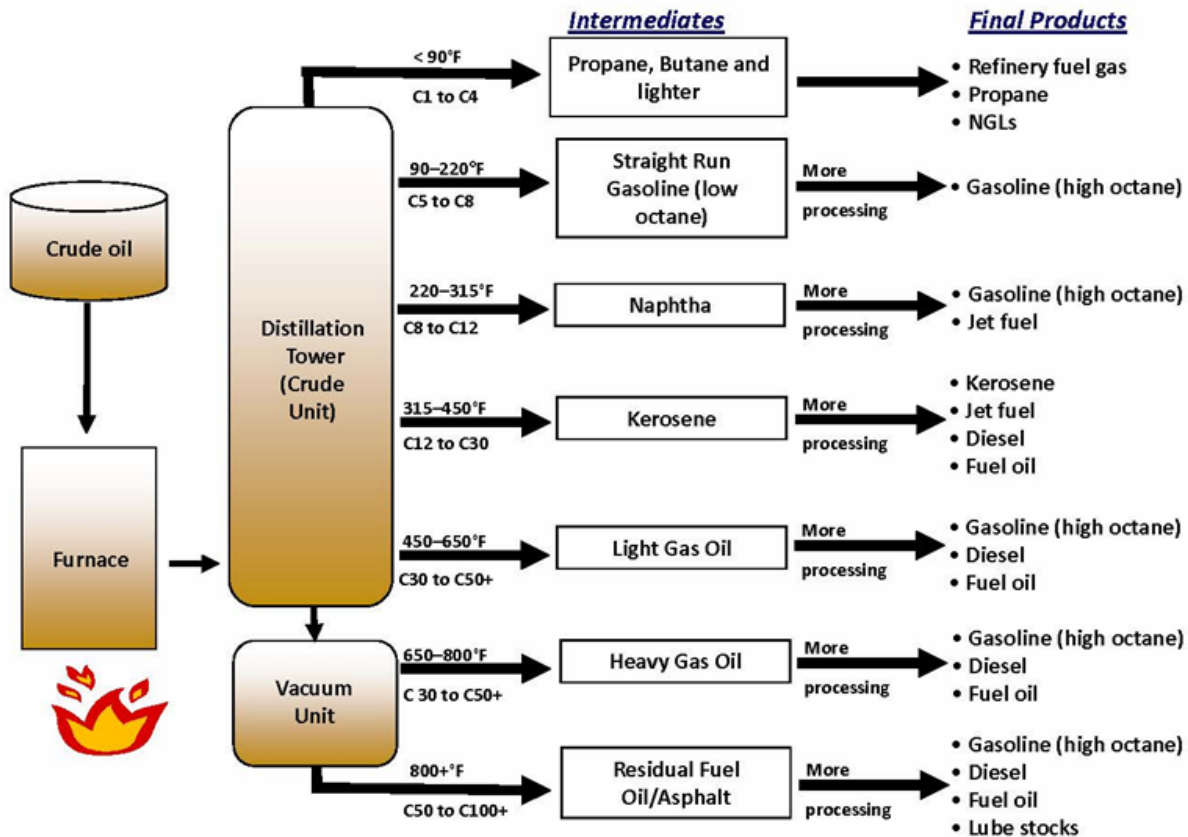


Crude Composition Does Not Impact Refinery Combustion Emissions

Refinery process heaters and boilers consume internally-produced fuel which may contain purchased natural gas as a supplement to meet total fuel demand. The primary source of refinery fuel gas is the light ends, or low boiling point hydrocarbons, naturally occurring in crude oil that are generated in the refining process. As depicted in the simplified process flow diagram below, the lightest hydrocarbons in the C1 (methane) to C2 (ethane) range are directed toward refinery fuel gas while C3s and C4s are preferentially sent to commercial products such as propane, butane, and natural gas liquids.



Refinery fuel gas is initially produced during the atmospheric and vacuum distillation processes, the first processes the crude (or mixture of crudes known as the “crude slate”) encounters. Hydrocarbon cracking processes such as Hydrocracking, Fluid Catalytic Cracking (FCCU) and Coking produce additional light-ends, some of which fall in the boiling point range for refinery fuel gas (C1s & C2s). Seasonal motor gasoline blending changes required by the California Air Resources Board (CARB) specifications and facility-wide refinery fuel gas balances can result in some normal butane being directed to refinery fuel gas as well; however, for economic reasons this normal butane blending is minimized because the normal butane has more value when converted to isobutane and blended into commercial products. In every scenario, purchased natural gas, which is predominately methane, is minimized.

Because refinery fuel gas is constrained to contain methane (C1) and ethane (C2) as the primary components, the mixture is indifferent as to where the methane or ethane was generated. Thus, C1s and C2s from cracking processes such as the FCCU or Coker are identical to C1s and C2s from basic distillation at the crude unit. Cracking processes do introduce some additional sulfur compounds into the raw refinery fuel gas steam, but these are removed by treatment before the fuel is used. The treatment of sulfur compounds is addressed below.

Combustion of refinery fuel gas produces NO_x, SO₂, CO and sulfuric acid mist (SAM) in well-understood and documented processes. The Refinery's Title V permit regulates NO_x and CO for every process heater and boiler by establishing emissions limits under Federal and BAAQMD regulations including source-specific permit conditions. The production of NO_x is driven by excess O₂, burner type, firebox temperature, residence time and any abatement such as selective catalytic reduction (SCR) or ammonia injection (selective non-catalytic reduction-SNCR). During normal operations, heat transfer demand from the fired source to the process is controlled by throughput (feed to the unit) and other production variables (such as catalyst activity) to maintain relatively stable combustion of refinery fuel gas. Because the refinery fuel gas is consistently a combination of C1s and C2s distilled or cracked from the crude slate with purchased natural gas added as needed, the refinery fuel gas combustion emissions for NO_x are unchanged by changes in the crude slate.

NO_x and CO vary inversely as excess O₂ is adjusted. Simply put, increasing excess O₂ typically increases NO_x and decreases CO for given combustion source fired condition because complete combustion is promoted with ample excess oxygen. For energy conservation, excess oxygen is minimized to just above the point where CO production could become unstable beyond acceptable limits. This combustion tuning procedure minimizes NO_x as well. This balance between NO_x and CO is not dependent on the crude slate or refinery fuel gas qualities other than maintaining the heating value (HHV) within a reasonable range to promote good and stable combustion in a well-tuned furnace.

EPA and the BAAQMD impose sulfur limitations on refinery fuel gas, both total reduced sulfur (TRS) and H₂S, with specific concentration and averaging periods as documented in the Title V permit. For some facilities the Title V permit contains 7 unique permit limits for sulfur in refinery fuel gas with 5 different averaging periods. Short term limits such as 162 ppm H₂S for 3-hours and 155 ppm TRS in a calendar day do not reflect the degree of control required on a daily basis that the longer term limits impose such as a limit of 35 ppm TRS in a rolling 365-day period for recently built sources that underwent NSR. No matter what the sulfur content might be in any crude oil or crude slate, the refinery fuel gas sulfur content is controlled to meet permit limits by treating the fuel gas with Methyl Ethyl Amine (MEA) to remove H₂S and with "sponge oil" to remove TRS constituents other than H₂S. The refinery fuel gas treatment systems monitor and analyze for sulfur content (TRS & H₂S) on a real-time basis to adjust treatment as needed to maintain compliance. Consequently, the sulfur-based emissions associated with combusting refinery fuel gas are essentially unaffected by changes in crude slate. In fact, any increase in refinery fuel gas sulfur concentration actually results in increased sulfur recovery during the fuel gas treatment processes which translates to increased commercial sales of molten elemental sulfur.

Sometimes source-specific sulfuric acid mist limits are imposed on newer sources; however, the production of sulfuric acid mist is driven by the sulfur content in the refinery fuel gas (producing SO₂) and the stack temperature (driving dissociation of sulfuric acid mist into SO₂ and water). As explained above, the sulfur content of refinery fuel gas is not expected to

change with changes in crude slate because sulfur recovery increases whenever refinery fuel gas treatment increases. Thus the input to the formation of sulfuric acid mist is not expected to change beyond the current performance boundaries.

Conclusion: Criteria pollutant emissions are already constrained by existing permit conditions and limits. Changes to the refinery crude slate may increase recovery of sulfur, but do not necessarily increase criteria pollutant emissions; many of these conditions and limits also result in controls of toxics which are in numerous cases a subset of a criteria pollutant. The composition of crude slates does not affect emissions.