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(54) Coal gasification process.

(57) Ash-slagging fixed bed gasification of carbonaceous materials with steam and oxygen is effected by substituting at least a portion of the steam with an aqueous liquor. The liquor may be water per se eg. boiler-feed water or an effluent liquor comprised of condensed organic compounds and unreacted steam and solubilised salts which liquor is obtained by treating the product gas. Although oxygen consumption is slightly increased, the economic effect is offset by not having to expend energy in steam raising.

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This invention relates to coal gasification processes.

During the gasification of coal with steam and oxygen an aqueous liquor is produced consisting mainly of solubilized phenolic compounds, ammonia, hydrogen sulphide, hydrogen cyanide, alkali metals and salts. This effluent cannot be discharged to waste without treatment since the biological oxygen demand is far too great for the environment to cope with without serious ecological effects. The problem is far more serious with ash-slagging processes than with dry-ash processes since the steam requirement for the process is generally less and the by-produced effluent liquors tend to be more concentrated.

Conventionally, these effluent liquors can be treated to remove phenols and ammonia before biological treatments. Alternatively the untreated or partially treated liquor can be incinerated, leaving a solid for disposal. All of these effluent treatment processes have some disadvantage and present technological difficulties.

The recycling of aqueous liquors obtained during the steam/oxygen gasification of coal is already known. For example, in PCT publication No WO 80/00974 there is disclosed a process wherein aqueous liquors obtained during the dry-ash, fixed bed gasification of coal is fed to an entrained bed ash-slagging gasifier. Similarly, US Patent Specification No 3971636 teaches recycling an aqueous condensate separated from synthesis gas obtained by the ash-slagging, fluidised bed gasification of coal. In these examples the aqueous liquor is used a vehicle for feeding coal fines in the form of slurries to the

gasifier.

Although in these references the primary gasifier is an ash-slagging gasifier, they had completely differing modes of operation. In neither case is the ash-slagging gasifier of fixed bed construction and because of this there are obvious advantages in that a non-fixed bed arrangement allows the liquor to be rapidly heated and thus eliminates any danger of the reactions being quenched.

Indeed as will be seen from the teachings in WO80/00974, effluent liquor obtained from the fixed bed stage is only recycled to the entrained stage.

From a consideration of the prior it would not be expected that recycle liquor injection could be successfully achieved with fixed bed ash-slagging gasifiers.

We have now surprisingly found that effective operation of a coal gasification under fixed bed, ash slagging can be achieved by direct injection of aqueous liquor together with other gasifying, and that where such liquor is an effluent liquor the problem of disposal is substantially alleviated.

Thus the present invention provides a process for the production of methane-containing gases wherein a feedstock comprising a solid carbonaceous material is gasified in the presence of steam and oxygen as gasifying agents, under fixed-bed, ash-slagging conditions and the

product gas is treated to remove therefrom unreacted steam, water soluble compounds and condensible organic compounds characterised in that at least a portion of the steam requirement for the reaction is provided by adding an aqueous liquor in admixture with the other gasifying agents.

Preferably the aqueous liquor is the effluent liquor derived from the treatment of the product gas. However, the aqueous liquor may comprise purer forms of water such as that used for cooling purposes or as boiler feed.

The recycled liquor is injected at the point where the other gasifying agents are added ie through tuyeres into the raceway. In practice the steam buffle and tuyeres would be modified to provide liquor or water at the point of steam injection.

The addition of the aqueous species confers a number of surprising advantages, although it was to be expected that such addition would have an adverse effect upon either the operation of the gasifier or the slag-tapping operations. However, in neither case was any difficulty noted. The oxygen consumption (based upon the amount of carbonaceous material consumed) was found to have increased slightly but this was more than offset in the savings in cost in not having to raise steam. In addition a considerable advantage accured in that if the liquor is aqueous effluent not only are there considerable savings in being able to reuse the water, but also the dissolved and suspended materials are disposed of in the reactor. The organic species are, of course,

useful as a reactant species.

Thus, in recycling liquor in this way the steam requirement for gasification is substantially reduced, for example, to about 50% of virtually all the liquor normally produced for a bituminous coal is recycled. Up to 50% the total H_2O species requirement for the gasification reaction may be provided by the aqueous liquor viz as water per se or as recycled liquor. A further advantage is that inorganic materials contained in the effluent liquor and taken up by the slag and thus are removed, with the slag, from the system. The heavy metal content of the slag eg. zirconium is increased compared with no liquor injection being employed. A bleed off of some of the liquor may be desirable for treatment to remove chlorides and other salts when build up of these compounds in the recycling liquor begins to occur. The aqueous liquor may contain some organic species dissolved or emulsified therein. However, in addition, the liquor may be used as vehicle for conveying suspended solid materials, ie coal fines, to the reactor.

The invention will now be illustrated by reference to the following example:

A fixed-bed, ash-slagging coal gasification plant, for example as in "The Chemistry of Coal Utilization", 2nd Supplementary Volume, 1981, published by John Wiley & Son, Inc, was modified to allow injection of liquid aqueous species down the steam oxygen tuyeres. The plant was started up according to conventional techniques for the steam/oxygen gasification on Markam Mains Coal at a working pressure of

24.78 bar(g). The reactant feed rates and gas production rate are summarized in the following Table. In colum A, the reactant rates prior to liquor injection are given. Liquor injection was increased by the steps shown in Columns B, C and D over a period of 21 hours.

	A	B	C	D
Coal Feed Rate (locks hr^{-1})	3.89	3.90	3.83	3.76
Steam Flow Rate (m^3 hr^{-1})	5418	4827	4482	4182
liquor Injection Rate (kg hr^{-1})	0	440.38	708.24	817.20
Overall H_2O/O_2 ratio	1.16	1.17	1.18	1.16
Gas Flow (m^3 hr^{-1})	21165	21672	20961	20482

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CLAIMS

1. A process for the production of methane-containing gases wherein a feedstock comprising a solid carbonaceous material is gasified in the presence of steam and oxygen as gasifying agents, under fixed-bed ash-slagging conditions and the product gas is treated to remove therefrom unreacted steam, water-soluble compounds and condensible organic compounds, characterised in that at least a portion of the steam requirement for the reaction is provided by adding an aqueous liquor in admixture with the other gasifying agents.

2. A process as claimed in Claim 1 wherein said aqueous liquor is water per se.

3. A process as claimed in claim 1 wherein said liquor comprises an effluent liquor containing condensed unreacted steam, water soluble compounds and condensed organic compounds, obtained by treating said product gas.

4. A process as claimed in Claim 2 or Claim 3 wherein up to 50% of the H_2O species required for the gasification reaction are provided by aqueous liquor.

5. A process as claimed in Claim 1 wherein said aqueous liquor is a vehicle for suspended materials.

6. A process as claimed in Claim 5 wherein said suspended materials are coal fines.