PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2006/006225	22.06.2006	06.07.2005

International Patent Classification (IPC) or both national classification and IPC
INV. C07C2/82 C07C2/78 C07C5/09 C07C5/52

Applicant
SAUDI BASIC INDUSTRIES CORPORATION

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	see form PCT/ISA/210	O'Sullivan, Paul Telephone No. +31 70 340-4511

Form (PCT/ISA/237) (Cover Sheet) (April 2005)

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

      ☐ a sequence listing

      ☐ table(s) related to the sequence listing

   b. format of material:

      ☐ on paper

      ☐ in electronic form

   c. time of filing/furnishing:

      ☐ contained in the international application as filed.

      ☐ filed together with the international application in electronic form.

      ☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-16
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-16
Industrial applicability (IA)	Yes:	Claims	1-16
	No:	Claims	

2. Citations and explanations

see separate sheet

Re: Item V

Reference is made to the following documents; the numbering will be adhered to in the rest of the procedure:

D1: US-A-5 270 016 (ALAGY ET AL) 14 December 1993 (1993-12-14)
D2: US-A-4 726 913 (BROPHY ET AL) 23 February 1988 (1988-02-23)
D3: 1983-755483 (WPI abstract)
D4: US-A-5 824 834

Novelty (Art 54 EPC)

D1 discloses an apparatus for thermal conversion of methane to hydrocarbons of higher molecular weight. In example 2 of D1, it can been seen that the main products, apart from hydrogen and methane starting material, are acetylene and ethylene. In one embodiment of D1, it is noted that direct quenching of the effluent may be carried out. The effluent from the reactor is cooled very rapidly by putting it into direct contact with cooling fluid which may be chosen from liquifed petroleum gases, propane, hydrocarbon oils or water. According to D1 , 'Propane is the preferred quenching gas, since it can also be partially cracked and thus contribute to the formation of products such as ethylene'. Thus is is clear said in D1 that adding alkanes such as propane to the acetylene effluent lead to the formation of products such as ethylene. However, D1 does not disclose the conversion if acetylene into ethylene by intimately mixing the acetylene containing effluent with an ethane feed as required by claim 1. Claims 1-16 may therefore be considered novel over D2.

D2 discloses a process for the production of synthesis gas and hydrocarbons(D1, column 1, lines 49-60) (note syn gas is necessarily produced in the conversion of methane to acetylene, see application page 9, second paragraph). Methane may be used as feed (column 2, line 7). Preferred products are acetylene, ethylene, higher olefins, aromatics and synthesis gas (column 2, lines 59-63). It is mentioned on column 3, lines 10-17 that: " .. an alternative mode of quench is envisaged if it is required to increase the amount of unsaturated hydrocarbons in the product gases. This mode comprises the injection of, for example, a liquid saturated hydrocarbon e.g. propane, butane or gasoline, into the hot product gases and to thereby increase the content of light unsaturated hydrocarbons, e.g.

ethylene, acetylene in the product gases". However, D2 does not disclose the conversion if acetylene into ethylene by intimately mixing the acetylene containing effluent with an ethane feed as required by claim 1. Claims 1-16 may therefore be considered novel over D2.

D3 does not disclose the conversion of a feed charge containing methane to acetylene.

D4 does not disclose the production of ethylene from acetylene and ethane.

Inventive Step (Art 56 EPC)

1. The difference between D1 and the present claims is that D1 does not disclose the conversion if acetylene into ethylene by intimately mixing the acetylene containing effluent with an ethane feed, although D1 (see table column 15) does result in the production of ethylene. D1 does discloses (column 6, lines 27-37) that the product of the reaction which contains acetylene may be quenched using propane as the preferred quenching gas, since it can also be partially cracked and thus contribute to the formation of products such as ethylene. The problem underlying the present application may therefore be considered as the provision of an alternative process for the production of ethylene. It is not clear from the disclosure of D1 whether propane reacts directly with acetylene to produce ethylene and propylene or whether propane is merely cracked to produce products such as ethylene without reacting with the product acetylene. Even should the propane react with acetylene, it is not exclusively the desired ethylene that results. Therefore the skilled person looking for an alternative to the process of D1 would not be given any incentive to make the changes to the process resulting in the presently claimed embodiments. Claims 1-16 are therefore considered inventive over D1.

2. Novelty of the present claims with respect to D2 is discussed above. It is mentioned in D2, column 3, lines 10-17 that: " .. an alternative mode of quench is envisaged if it is required to increase the amount of unsaturated hydrocarbons in the product gases. This mode comprises the injection of, for example, a liquid saturated hydrocarbon e.g. propane, butane or gasoline, into the hot product gases and to thereby increase the content of light unsaturated hydrocarbons, e.g. ethylene, acetylene in the product gases". The fact that the addition of saturated hydrocarbons is presumed to increase the content of light unsaturated hydrocarbons *including* acetylene is something which would point the skilled

person away from the teaching of D2 should he be seeking an alternaitve process for the production of ethylene. Present claims 1-16 are therefore considered inventive over D2.

3. D3 may be considered as the closest prior art since it discloses a process for the conversion of acetylene and ethane into ethylene (examples, second paragraph). This reaction is carried out thermally in the absence of a catalyst. The difference between D3 and the present claims is that D3 does not disclose the first step of the process, the conversion of methane to acetylene. The problem may then be formulated as the provision of a source of acetylene, which has not been provided in D3. The skilled person would then look to D4 as a possible source of acetylene. The thermal conversion by pyrolysis or paratial oxidation of a feed clarge containing methane into an acetylene containing effluent is (as acknowledged on page 1 of the description) well known in the art. Although the present claim refers to the hydrogenation as being *in-situ*, the only embodiments of the presents invention refer to the hydrogenation reaction; it is merely mentioned that the 'pyrolysis and partial oxidation step as applied is available in the prior art documents'. It is thus considered that the skilled person would, without any inventive ability, combine the teaching of D3 and D4 in order to arrive at the present invention. Claims 1-16 are therefore not considered inventive over the combined teaching of D3 and D4.